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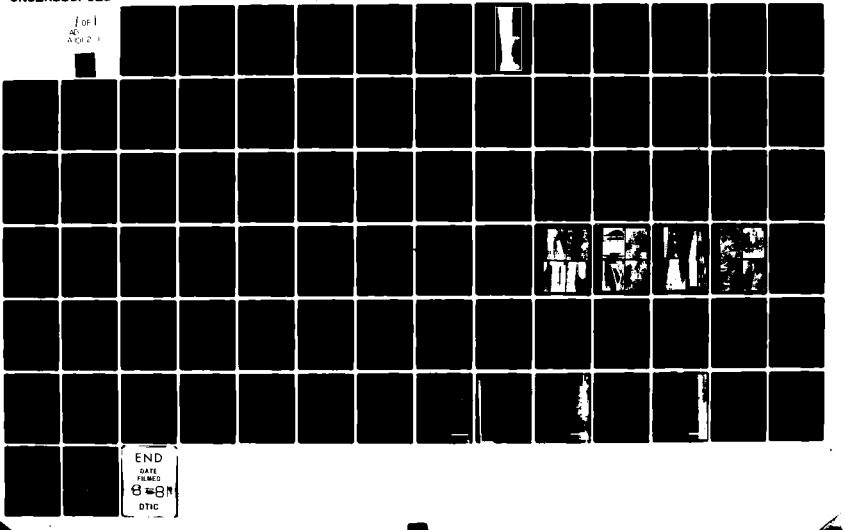

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OHIO RIVER BASIN
SARVER RUN
BUTLER COUNTY

PENNSYLVANIA

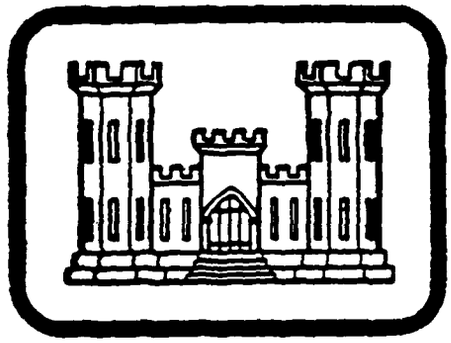
NDI No. PA 01073
PENN DER No. 10-63

LAKE SAXONY DAM

~~SAXONY FARMS~~

DACW31-81-C-0027

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



PREPARED FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS
BALTIMORE, MARYLAND 21203

BY

ACKENHEIL & ASSOCIATES GEO SYSTEMS, INC.
CONSULTING ENGINEERS
1000 BANKSVILLE ROAD
PITTSBURGH, PENNSYLVANIA 15216

MAY 1981

OHIO RIVER BASIN

LAKE SAXONY DAM
BUTLER COUNTY, COMMONWEALTH OF PENNSYLVANIA
NDI NO. PA 1073
PennDER NO. 10-63

SAXONY FARMS

PHASE I INSPECTION REPORT,
NATIONAL DAM INSPECTION PROGRAM.

Lake Saxony Dam, (NDI Number PA-01073,
Penn DER Number 10-63) Ohio River Basin,
Sarver Run, Butler County, Pennsylvania.
Phase I Inspection Report.

Prepared for: DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

Prepared by: ACKENHEIL & ASSOCIATES GEO SYSTEMS, INC.
Consulting Engineers
1000 Banksville Road
Pittsburgh, Pennsylvania 15216

Date: 11 May 1981

PREFACE

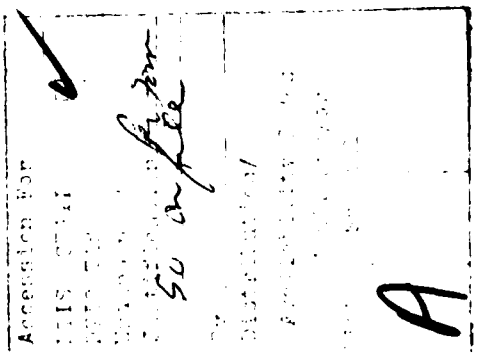
This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I investigations. Copies of these guidelines may be obtained from the Department of the Army, Office of Chief of Engineers, Washington, D.C. 20314.

The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon visual observations and review of available data. Detailed investigations and analyses involving topographic mapping, subsurface investigations, materials testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for such studies which should be performed by the owner.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of the dam depends on numerous and constantly changing internal and external factors which are evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some time in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Design Flood is based on the estimated "Probable Maximum Flood" (PMF) for the region (greatest reasonably possible storm runoff), or fractions thereof. The Spillway Design Flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS

NAME OF DAM:	Lake Saxony
STATE LOCATION:	Pennsylvania
COUNTY LOCATION:	Butler
STREAM:	Sarver Run
DATE OF INSPECTION:	2 December 1980
COORDINATES:	Lat. 40°45'06"
	Long. 79°47'36"

ASSESSMENT

Based on a review of available information and visual observations of conditions as they existed on the date of the field inspection, the general condition of Lake Saxony Dam is considered to be good.

This assessment is based primarily on visual observations of the embankment and appurtenances and hydrologic/hydraulic analyses of reservoir/spillway capacity.

The structure is classified as a "small" size, "high" hazard dam. Corps of Engineers guidelines recommend one-half to one times the Probable Maximum Flood (PMF) as the Spillway Design Flood for a "small" size, "high" hazard dam. Lake Saxony Dam's Spillway Design Flood is one-half the Probable Maximum Flood. Spillway capacity is "adequate" because the non-overtopping flood discharge was found, by using the HEC-1 computer program, to be in excess of 100 percent of the PMF.

The Phase I Investigation of Lake Saxony Dam revealed a downstream spring that should be investigated further and several minor deficiencies which should be corrected or monitored.

RECOMMENDATIONS

1. Additional Investigation: It is recommended that the owner retain the services of a registered professional engineer, knowledgeable and experienced in design and construction of earth dams, to provide an evaluation of the source and nature of the downstream spring and to provide recommendations for monitoring and control.

2. Emergency Operation and Warning Plan: The owner should develop an Emergency Operation and Warning Plan including:

a. Guidelines for evaluating inflow during periods of heavy precipitation or runoff;

b. Procedures for around the clock surveillance during periods of heavy precipitation or runoff;

c. Procedures for drawdown of the reservoir under emergency conditions;

d. Procedures for notifying downstream residents and public officials, in case evacuation of downstream areas is necessary.

3. Remedial Work: The Visual Inspection disclosed four minor deficiencies which should be corrected or monitored. These are:

a. Backfilling the animal burrow on the embankment's downstream slope;

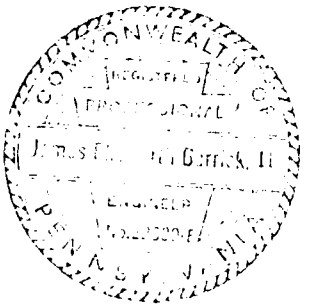
b. Removal of trees and brush from the embankment's downstream slope;

c. Implementation of a regularly scheduled monitoring program to observed seeps and wet zones in the embankment's downstream toe area and the wet zones in the emergency spillway channel;

d. Repair of the displaced concrete erosion protection slab and removal of vegetation from all slab joints.

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS (CONT'D)
Lake Saxony Dam

Samuel G. Mazzella 8 May 1981
Samuel G. Mazzella Date
Project Engineer



James P. Hannan 7 May 1981
James P. Hannan Date
Project Engineer

James E. Barrick 8 May 81
James E. Barrick, P.E. Date
PA Registration No. 022639-E

Approved by: James W. Peck
James W. Peck
Colonel, Corps of Engineers
District Engineer

22 May 81
Date

LAKE SAXONY DAM

OVERVIEW

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
LAKE SAXONY DAM
NATIONAL I. D. NO. PA 01073
PennDER No. 10-63

SECTION 1
PROJECT INFORMATION

1.1 GENERAL

a. Authority: This Phase I investigation was performed pursuant to authority granted by Public Law 92-367 (National Dam Inspection Act) to the Secretary of the Army, through the Corps of Engineers, to conduct inspections of dams throughout the United States.

b. Purpose: The purpose of the investigation is to make a determination on whether or not the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Dam and Appurtenances:

(1) Embankment: Lake Saxony Dam was designed and constructed as an earthfill structure with a cutoff trench. The trench is 6 feet deep and is located along the centerline of the embankment. The upstream slope has concrete slab type erosion protection.

The embankment is 350 feet long (excluding spillway), 25.7 feet high, and has a crest width that varies from 20 to 35 feet. The upstream slope was observed to be 3.5 H:1V above the waterline. The downstream slope was observed to range from 2.5 H:1V to 2.3H:1V.

(2) Principal Spillway: The principal spillway consists of a reinforced concrete drop inlet structure with flow control weirs on opposite sides (perpendicular to the embankment crest). A 16 inch diameter concrete encased CMP outlet pipe is located through the embankment along the original stream channel. Discharge is at the toe of the embankment.

(3) Outlet Works: The principal spillway conduit also acts as an outlet works for this facility. The control slide gate is on the upstream side of the intake structure and is controlled by a handwheel on the access bridge.

(4) Emergency Spillway: The emergency spillway is a trapezoidal open channel located on the left abutment. The channel's bottom and side slopes are grass covered.

(5) Roadway Embankment: A roadway embankment has been constructed across the emergency spillway discharge channel approximately 250 feet downstream of the reservoir. The embankment has a minimum height of 9.8 feet and contains three 36 inch corrugated metal pipes (CMP) that permit partial drainage of the discharge channel.

(6) Downsteam Conditions: Sarver Run, below Lake Saxony Dam, flows through a wide, moderately sloped valley for about 3000 feet below the dam. From this point to the village of Coal Hollow, a distance of about two miles, the valley becomes moderately to steeply sloped.

At 3.6 miles below the dam, Sarver Run joins Little Buffalo Creek which flows an additional 2.5 miles to a confluence with Buffalo Creek at Winfield Junction. From there, Buffalo Creek flows 2.7 miles to a confluence with the Allegheny River at Freeport, Pennsylvania.

(7) Reservoir: Lake Saxony Dam's reservoir is 1600 feet long at normal pool elevation and has a normal surface area of 9.6 acres. When the pool is at the crest of the dam, the reservoir length increases to 3,800 feet and the surface area is 46.9 acres.

(8) Watershed: The watershed contributing to Lake Saxony consists mostly of farmland, pasture and woodland; there is also residential development. The watershed above the dam is 1.1 square miles.

b. Location: Lake Saxony Dam is located across Sarver Run, in Jefferson Township, Butler County, Pennsylvania. The dam is approximately one mile east of Saxonburg, Pennsylvania.

c. Size Classification: The dam has a maximum storage capacity of 320 acre-feet and a maximum toe to crest height of 25.7 feet. Based on the Corps of Engineers guidelines, this dam is classified as a "small" size structure.

d. Hazard Classification: Lake Saxony Dam is classified as a "high" hazard dam. In the event of a dam failure, at least nine inhabited dwellings on the floodplain below the dam would be subjected to possible damage and loss of more than a few lives could result.

e. Ownership: Lake Saxony Dam is owned by Saxony Farms. Correspondence should be addressed to:

Saxony Farms
Saxonburg, Pennsylvania 16056
Attention: Mr. D. L. Reynolds
(412) 352-3961

f. Purpose of Dam: Lake Saxony Dam was constructed to provide a water supply for fire protection, irrigation and stock watering.

g. Design and Construction History: Lake Saxony Dam was designed by Gilbert P. Fleetwood, P.E. A permit to construct a dam across Sarver Run was issued by the Commonwealth of Pennsylvania, Department of Forests and Waters, Division of Dams (predecessor to PennDER), on 13 July 1956.

Construction was begun in July 1956 and was completed in April 1958. The dam was constructed by Highway Equipment Company of Pittsburgh, Pennsylvania, and Saxony Farms of Saxonsburg, Pennsylvania. A representative of Saxony Farms was on-site during construction work. Construction progress reports were submitted semi-monthly to the Division of Dams.

1.3 PERTINENT DATA

a. Drainage Area	1.1 sq. mi.
b. Discharge	
Maximum Flood at Dam	Unknown
Emergency Spillway Capacity at Current Top of Dam	10,350 cfs
Emergency Spillway Capacity at Design Top of Dam	9,520 cfs
Roadway Embankment Capacity at Current Top of Dam At Least	6,550 cfs
c. Elevation (feet above MSL)	
Current Top of Dam (low point)	1270.4
Design Top of Dam	1270.0*
Roadway Crest (low point)	1265.5
Emergency Spillway Crest (average)	1260.9
Normal Pool	1259.5*
Principal Spillway Crest	1259.5*
Outlet Works Inlet Invert	1246.0*
Outlet Works Discharge Invert	1245.0*
Embankment Downstream Toe	1244.7
d. Reservoir Length	
Length of Maximum Pool	3,800 feet
Length of Normal Pool	1,600 feet
e. Reservoir Storage	
Current Top of Dam	320 acre-feet
Design Top of Dam	302 acre-feet
Roadway Crest	143 acre-feet
Emergency Spillway Crest	55 acre-feet
Principal Spillway Crest	45 acre-feet

f. Reservoir Surface

Current Top of Dam	46.9 acres
Design Top of Dam	45.0 acres
Roadway Crest	26.4 acres
Emergency Spillway Crest	12.5 acres
Principal Spillway Crest	9.6 acres

g. Embankment

Type	Earth
Length	350 feet
Height	25.7 feet
Crest Width	Varies from 20 to 35 feet
Slopes	
Downstream	2.5H:1V to 2.3H:1V
Upstream	3.5H:1V*
Impervious core	Yes*
Cutoff provisions	Yes*
Grout Curtain	Unknown

h. Principal Spillway

Type	16 inch diameter concrete encased CMP
Location	Through Embankment
Upstream Flow Control	Yes*
Inlet Invert (Riser Structure)	1259.5
Trash Cage	Yes
Conduit Length	160 feet*
Slide Gate	Upstream*
Anti-seep Collars	Yes, 9*

i. Emergency Spillway

Type	Trapezoidal Open Channel
Location	Left Abutment
Overflow Crest Length	84.5 feet
Crest Elevation (average)	1260.9
Discharge Channel Slope	2%*

j. Roadway Embankment

Location	Emergency Spillway Discharge Channel
Overflow Crest Length	590+ feet
Crest Elevation (low point)	1265.5

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*Taken or derived from original specifications and/or drawings.

SECTION 2
ENGINEERING DATA

2.1 DESIGN

a. Data Available: The following written information and data may be obtained from the Pennsylvania Department of Environmental Resources, Harrisburg, Pennsylvania. The information was reviewed for this study.

(1) Application and permit for construction of a dam owned by Saxony Farms of Saxonburg, Pennsylvania.

(2) Set of design drawings by Gilbert P. Fleetwood, P.E., dated June 1955.

(3) Set of modified design drawings by Gilbert P. Fleetwood, P.E., dated June 1955.

(4) One report dated 29 June 1956 by the Chief of the Dams Division, Water and Power Resources Board, recommending approval of the permit to construct a dam.

(5) Construction progress reports from the owner to the Water and Power Resources Board.

(6) Set of design drawings with construction modifications penciled in.

(7) One inspection report dated 7 August 1967 by state personnel.

b. Design Features: The embankment and appurtenances were designed in accordance with Water and Power Resources Board criteria.

(1) Field Investigation: There was no information available concerning a pre-design geotechnical investigation.

(2) Embankment: The embankment was designed to be a compacted, zoned earthfill structure. The upstream and downstream slopes were designed to be 3H:1V but, according to the as-built drawings, were changed to 2.5H:1V during construction. The crest width varies from 20 to 35 feet. The central core was to be constructed of "most impervious materials" with a 6 feet deep trapezoidal key trench. The upstream face was to be "less impervious materials" with the coarser materials tending towards the bottom of the embankment. The downstream face was to be "more pervious materials" with a two foot thick drainage blanket at the embankment's base.

(3) Principal Spillway: The principal spillway was designed as a reinforced concrete drop inlet structure with concrete encased corrugated metal outlet pipe. The flow control weirs are located on opposite sides of the rectangular opening.

(4) Outlet Works: The slide gate for the outlet works was designed for operation from a handwheel located atop the principal spillway access bridge.

(5) Emergency Spillway: The emergency spillway was designed as a grass-lined open channel with trapezoidal cross-section in the left abutment.

2.2 CONSTRUCTION

a. Contractor: The Highway Equipment Company of Pittsburgh, Pennsylvania, and Saxony Farms constructed Lake Saxony Dam.

b. Construction Period: The embankment and appurtenances were constructed between July 1956 and April 1958.

c. Field Changes: According to the drawings supplied to the Pennsylvania Department of Environmental Resources by the owner several field modifications were made during construction. The most significant changes were shifting the location of the emergency spillway and relocating the roadway embankment.

d. Construction Inspection: One on-site inspection of construction was performed by representatives of the Commonwealth of Pennsylvania. Throughout construction, the work was monitored by the owner and semi-monthly reports were submitted to the Division of Dams.

2.3 OPERATION

According to the Water and Power Resources Board, Saxony Farms is responsible for the operation of Lake Saxony Dam.

The principal and emergency spillways are uncontrolled and performance and operation records are not maintained.

The outlet works is normally closed.

The dam does not require a dam tender.

2.4 EVALUATION

a. Availability: Available design information and drawings were obtained from the Pennsylvania Department of Environmental Resources and were supplemented by conversations with representatives of Saxony Farms.

b. Adequacy: The available design information, supplemented by field inspections and the engineering analyses in succeeding sections, is adequate for the purpose of the Phase I Inspection Report.

c. Validity: There appears to be no reason to question the validity of the available design information and drawings.

SECTION 3
VISUAL INSPECTION

3.1 FINDINGS

a. General: The field inspection of Lake Saxony Dam was performed on 2 December 1980, and consisted of:

(1) Visual observations of the embankment crest and slopes, groins and abutments;

(2) Visual observations of the principal and emergency spillways including intake structures, outlet structures, and approach and discharge channels;

(3) Visual observations of the embankment's downstream toe area including drainage channels and surficial conditions;

(4) Transit stadia field measurements of relative elevations along the embankment crest centerline, spillway, and across the embankment slopes;

(5) Visual observations of the reservoir shoreline and watershed;

(6) Visual observations of downstream conditions and evaluation of the downstream hazard potential.

The visual observations and measurements were made during periods when the reservoir and tailwater were at normal operating levels.

The visual observations checklist, field sketch, and field section and profiles, including the observations and comments of the field inspection team, are contained in Appendix A. Specific observations are illustrated on photographs in Appendix C. Detailed findings of the field inspection are presented in the following sections.

b. Dam Configuration: Lake Saxony Dam is an earthen impounding embankment constructed across Sarver Run tc form Lake Saxony. The principal spillway is a drop inlet/conduit structure that maintains the reservoir pool level at approximately Elevation 1259.5. Storm flows are discharged through an open channel emergency spillway on the left abutment. A private roadway crosses the embankment and emergency spillway.

c. Embankment:

(1) Crest: The crest of Lake Saxony Dam was generally level and contained no visible cracks, depressions, or unusual characteristics. The crest was thoroughly vegetated and appeared to be well maintained.

A black-top covered road occupied a portion of the crest near the right abutment. The asphalt surface showed no signs of cracking or distress that might be related to embankment movements.

(2) Upstream Slope: The upstream face of the embankment was generally uniform and showed no signs of cracking, bulging or other movements indicative of embankment distress. The upstream face was completely vegetated and appeared to be well maintained.

The concrete slab erosion protection was in good condition. One slab near the approach channel to the emergency spillway had suffered some minor displacement.

(3) Downstream Slope: The downstream slope of the embankment was generally uniform and covered with brush and small trees. There were no signs of significant bulges, scarps, cracks or sloughing that would be indicative of embankment distress. There were no signs of high ground water within the embankment.

A swampy zone was observed in the junction between the embankment and the right abutment. The swampy zone extended from approximately mid-height of the embankment down to the stilling pool below the principal spillway outlet structure. Two seeps were flowing from the embankment along the wingwalls of the outlet structure. The seep on the right appeared to have a greater discharge than the seep on the left but flow quantities were too small to estimate. Both seeps were located in a region of significant iron staining.

An animal burrow was observed near the junction of the embankment and the abutment on the left side of the dam just below the road.

d. Abutments:

(1) Right: The right abutment at and above the embankment is mildly sloped and heavily wooded. The abutment slope steepens in the downstream direction, becoming relatively steep below the downstream toe of the embankment.

In the reach below the embankment, the right abutment was heavily wooded and contained considerable underbrush. There were no signs of seepage, erosion or slope distress on any portion of the right abutment.

(2) Left: The left abutment is mildly sloped and wooded in the vicinity of the dam. There were no indications of seepage, erosion or slope distress anywhere on the left abutment.

e. Principal Spillway:

(1) Intake Structure: The principal spillway intake structure is a reinforced concrete riser with anti-vortex wingwalls. Lake flows enter the riser by passing over two 5 foot long concrete walls. The opening is protected by a grate constructed of #8 reinforcing bars on six to eight inch centers. The visible concrete and steel components of the structure were in good condition.

(2) Conduit: The principal spillway conduit is a 16 inch diameter CMP that connects the intake structure with the outlet structure. The visible portion of the conduit at the downstream toe of the dam appeared to be in good condition.

(3) Outlet Structure: The principal spillway outlet structure consists of a concrete headwall with concrete wingwalls and is located at the downstream toe of the embankment. On the date of inspection, the outlet structure was in good condition.

f. Outlet Works: The outlet works for Lake Saxony Dam is a handwheel operated slide gate on the upstream face of the principal spillway intake structure. On the date of inspection, no handwheel was available and the gate was not operated. The Owner's representative indicated that the gate had been used effectively in 1978 to lower the lake level for an underwater inspection of the outlet works and principal spillway intake structure. The slide gate structure was reported to be in good condition at that time.

g. Emergency Spillway:

(1) Approach Channel: The emergency spillway approach channel was clear and free of obstructions and debris that might hinder flows from entering the spillway channel.

(2) Concrete Sill: The top of a concrete sill which is embedded in the spillway channel bottom, was in good condition.

(3) Discharge Channel: The emergency spillway discharge channel is obstructed by a roadway embankment. The embankment contains a culvert consisting of three 36 inch diameter CMP's that allows drainage of low spillway flows.

Two swampy areas were observed on the bottom of the emergency spillway channel. The origin of the swampy conditions could not be determined, but there was no strong indication that they are the result of seepage from the reservoir.

An erosional gully has developed at the downstream end of the emergency spillway discharge channel. The gully was 2 to 3 feet deep, but was well vegetated. No significant active erosion was observed.

h. Reservoir:

(1) Slopes: The slopes above the reservoir shoreline were generally mild and wooded. There were no indications of shoreline distress anywhere along the perimeter of the reservoir.

(2) Watershed: The watershed was generally as indicated by the U.S.G.S. topographic map. There were no indications of significant new construction or mining activities in the watershed. Considerable single family residential development appears to have occurred since the last revision of the map in 1969.

i. Downstream Conditions:

(1) Downstream Channel: The downstream channel below the principal spillway outlet structure is a riprap lined stilling pool that discharges to an unmaintained creek channel. The stilling pool was in good condition, although the riprap was overgrown with vegetation. The channel below the stilling pool was relatively straight and was overgrown with trees and underbrush.

(2) Downstream Spring: A spring, discharging an estimated 20 to 25 gallons per minute, was observed on the Sarver Run creek bank, approximately 250 feet below the crest of the embankment. A considerable amount of fine soil sediment was observed below the spring and the area was heavily iron stained. A sediment deposit was observed at the point where the spring flow entered the creek channel. The owner's representative advised that the spring predated the dam.

(3) Floodplain Development: In the first two miles below the dam there are at least nine inhabited dwellings on the floodplain at elevations low enough tc possibly be affected by high flows.

3.2 EVALUATION

The following evaluations are based on the visual inspection performed on 2 December 1980.

a. Embankment: The condition of the Lake Saxony Dam embankment was good. Only minor deficiencies of the embankment were observed. These included:

(1) Trees and underbrush growing on the downstream slope of the embankment.

(2) A displaced concrete slab in the erosion protection on the upstream face.

(3) An animal burrow near the junction of the embankment and left abutment.

(4) Two seeps and a swampy condition near the downstream toe of the embankment.

b. Principal Spillway: The condition of the principal spillway was good. There were no indications of structural deterioration or conditions that would hinder proper performance of the facility.

c. Outlet Works: The condition of the outlet works could not be determined. No handwheel was available to check performance of the slide gate.

d. Emergency Spillway: The condition of the emergency spillway was fair. This is based primarily on observations of adverse drainage conditions in the spillway as indicated by the two swampy areas. This evaluation does not consider the hydrologic/hydraulic performance of the spillway (and obstructing roadway embankment) as evaluated in Section 5 of this report.

e. Downstream Spring: The spring that is discharging sediment-laden waters downstream of the embankment may represent a potential threat to the impoundment. Although the spring was reported to have existed prior to construction of the dam, the origin of the recently deposited sediment materials should be investigated.

f. Hazard Potential: Based on the observed height of the dam and the downstream floodplain conditions, Lake Saxony Dam was assigned a "high" hazard potential rating.

SECTION 4
OPERATIONAL FEATURES

4.1 PROCEDURE

Reservoir pool level is maintained by the flow control weirs on the principal spillway.

Normal operating conditions do not require a dam tender.

The outlet works is normally closed.

4.2 MAINTENANCE OF DAM

The embankment and appurtenances are maintained by Saxony Farms. Maintenance reportedly consists of periodically repairing eroded areas and making miscellaneous necessary repairs.

4.3 INSPECTION OF DAM

Saxony Farms is required by the State of Pennsylvania to inspect the dam annually and make needed repairs.

4.4 WARNING PROCEDURE

There is no warning system and no formal emergency procedure to alert or evacuate downstream residents upon threat of a dam failure.

4.5 EVALUATION

The operating facilities at Lake Saxony Dam are considered to be adequate. The maintenance program should be continued. However, there are no written operation, maintenance or inspection procedures, nor is there a warning system or formal emergency procedure for this dam. These procedures should be developed in the form of checklists and step by step instructions, and should be implemented as necessary.

SECTION 5
HYDROLOGY AND HYDRAULICS

5.1 EVALUATION OF FEATURES

a. Design Data: The Lake Saxony Dam has a watershed of 700 acres which is primarily farmland, pasture, woodland and residential development. The watershed is about 1.7 miles long and 0.85 mile wide and has a maximum elevation of 1,360 feet (MSL). At normal pool, the dam impounds a reservoir with a surface area of 10 acres and a storage volume of 45 acre-feet. Normal pool level is maintained at Elevation 1259.5 by the principal spillway crest.

Design spillway capacity and embankment freeboard were made sufficient to accommodate 10,350 cubic feet per second which was considered sufficient for this structure and watershed at the time of design. Lake Saxony Dam's spillway capacity for the observed cross-section and existing freeboard condition is 10,350 cfs.

However, hydraulic control for the reservoir/spillway system was found to be located at the roadway embankment in the lower spillway discharge channel. The HEC-1 analysis was performed using stage-discharge characteristics of the roadway embankment.

No design hydrologic calculations were found relating reservoir /spillway/roadway embankment performance to the Probable Maximum Flood (PMF) or fractions thereof.

b. Experience Data: Records are not kept of reservoir level or rainfall amounts. There is no record or report of the embankment ever being overtopped.

c. Visual Observations: On the date of the field inspection, no serious deficiencies were observed that would prevent the principal and emergency spillways from functioning.

However, the roadway embankment across the spillway discharge channel appeared to be capable of obstructing high flows in the spillway.

d. Overtopping Potential: Overtopping potential was investigated through the development of the Probable Maximum Flood for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway system. The Corps of Engineers guidelines recommend 0.5 to 1 times the Probable Maximum Flood (PMF) for "small" size, "high" hazard dams. Based on the height of the dam and storage capacity of the impoundment and observed downstream conditions, Lake Saxony Dam has a Spillway Design Flood (SDF) of one-half the PMF. This designation considers the relatively small height of the dam, and the uninhabited, undeveloped floodplain conditions immediately below the dam.

Stage-discharge data was developed for the spillway's broad crested weir overflow section and the roadway embankment crest (also considered a broad crested weir). Examination of these data indicated that the roadway embankment would control the reservoir pool level during large storms.

Hydrometeorological Report No. 33 indicates the adjusted 24 hour Probable Maximum Precipitation (PMP) for the subject site is 19.1 inches. An evaluation of the reservoir/spillway/roadway system was performed to determine whether the storm discharge capacity is adequate under current Corps of Engineers guidelines.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U. S. Army Corps of Engineers, Davis, California, July 1978. The major methodologies and key input data for this program are discussed briefly in Appendix D.

The peak inflow to Lake Saxony Dam was determined by HEC-1 to be 2,380 cfs for a full PMF. The peak inflow for the SDF was 1,190 cfs.

An initial pool elevation of 1,259.5 was assumed prior to commencement of the storm.

e. Spillway Adequacy: The capacity of the combined reservoir/spillway/roadway system was determined to be in excess of one PMF by HEC-1. At the SDF, Lake Saxony Dam is not overtopped. According to Corps of Engineers' guidelines, Lake Saxony Dam's spillway is "adequate".

SECTION 6
STRUCTURAL STABILITY

6.1 AVAILABLE INFORMATION

a. Design and Construction Data: All available design documentation, calculations and other data received from the Pennsylvania Department of Environmental Resources were reviewed. The dam and appurtenances were designed by Gilbert P. Fleetwood, P.E. There were no structural design calculations available for review. A detailed list of available information is found in Appendix B.

The embankment was designed as a zoned, compacted earthfill structure with impervious core and foundation cutoff. There was to be a two foot thick drainage blanket under the downstream section of the embankment which would extend from the core to a small rock toe.

b. Operating Records: There are no written operating records or procedures for this dam.

c. Post-Construction Changes: There are no reported post-construction modifications to this dam.

d. Visual Observations: The field inspection disclosed no evidence of instability of either the embankment or spillway.

No direct embankment seepage or marked vegetal changes indicating a high groundwater level in the embankment were observed during the field inspection. However, swampy conditions were observed below the toe of the dam in the vicinity of the principal spillway outlet structure.

The junction of the embankment and the right abutment contained a swampy zone in the reach immediately above the toe of the embankment. Seepage and water-related vegetation were observed in the general vicinity.

e. Performance: There has been no indication or report of any problem related to performance of this dam over its twenty-three year life.

6.2 EVALUATION

a. Design Documents: The design documentation was, by itself, considered inadequate to evaluate the structures. There were no structural calculations associated with the stability of the embankment or of the appurtenant structures.

b. Embankment: Based on results of the visual observations of embankment slopes, materials, seepage and ground water conditions, Lake Saxony Dam appears to have an adequate margin of safety against sliding.

c. Principal and Emergency Spillways: Based on the visual observations, the principal and emergency spillway structures appeared to be stable.

d. Seismic Stability: According to the Seismic Risk Map of the United States, Lake Saxony Dam is located in Zone 1, where damage due to earthquakes would most likely be minor.

A dam located in Seismic Zone 1 may be assumed to present no hazard from an earthquake provided static stability conditions are satisfactory and conventional safety margins exist. No calculations were developed to verify this assessment, however.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS

7.1 ASSESSMENT

a. Evaluation:

(1) Embankment: Lake Saxony Dam's embankment is considered to be in good condition. This is based on visual observations that revealed only minor deficiencies.

(2) Principal Spillway: The condition of the principal spillway is considered to be good, although the outlet works and conduit could not be inspected.

(3) Emergency Spillway: The condition of the emergency spillway is considered to be good, with only minor deficiencies observed.

The Spillway Design Flood (SDF) for Lake Saxony Dam is one half the Probable Maximum Flood (PMF). The capacity of the combined reservoir/spillway/roadway system was determined by HEC-1 to be in excess of 100% of the Probable Maximum Flood.

(4) Downstream Spring: The spring observed approximately 250 feet below the downstream toe of the dam is considered to be a potential problem. Although the spring is reported to predate the dam, the apparent recent discharge of sediments suggests a possible piping condition.

(5) Emergency Plans: The lack of a documented emergency operation and warning plan is considered to be a deficiency.

b. Adequacy of Information: The information available on design, construction, operation and performance history in combination with visual observations and hydrology and hydraulic calculations was sufficient to evaluate the embankment and appurtenant structures in accordance with the Phase I investigation guidelines.

c. Urgency: The recommendations presented in Section 7.2 should be implemented immediately.

d. Necessity for Additional Data/Evaluation: Additional engineering information is required to adequately evaluate the hazard potential presented by the downstream spring.

7.2 RECOMMENDATIONS

a. Additional Investigation: It is recommended that the owner retain the services of a registered professional engineer, knowledgeable and experienced in design and construction of earth dams, to provide an evaluation of the source and nature of the downstream spring and to provide recommendations for monitoring and control.

b. Emergency Operation and Warning Plan: The owner should develop an Emergency Operation and Warning Plan including:

(1) Guidelines for evaluating inflow during periods of heavy precipitation or runoff.

(2) Procedures for around the clock surveillance during periods of heavy precipitation or runoff.

(3) Procedures for drawdown of the reservoir under emergency conditions.

(4) Procedures for notifying downstream residents and public officials, in case evacuation of downstream areas is necessary.

c. Remedial Work: The visual inspection disclosed four minor deficiencies which should be corrected or monitored. These are:

(1) Backfilling the animal burrow on the embankment's downstream slope.

(2) Removal of trees and brush from the embankment's downstream slope.

(3) Implementation of a regularly scheduled monitoring program to observed seeps and wet zones in the embankment's downstream toe area, and the wet zones in the emergency spillway channel.

(4) Repair of the displaced concrete erosion protection slab and removal of vegetation from all slab joints.

APPENDIX A

VISUAL INSPECTION CHECKLIST

VISUAL OBSERVATIONS CHECKLIST I
(NON-MASONRY IMPOUNDING STRUCTURE)

Name of Dam Lake Saxony County Butler State Pennsylvania National ID # PA 01073

Type of Dam Earth Hazard Category High

Date of Inspection 2 December 1980 Weather Cloudy, mild, light rain Temperature 50°F

Pool Elevation at Time of Inspection 1259.7 (MSL)
Tailwater at Time of Inspection 1244.7 (MSL)

Inspection Personnel:

J. E. Barrick, P.E.	Ackenheil & Associates, Project Manager and Hydrologist
J. P. Hannan	Ackenheil & Associates, Geotechnical Engineer
S. G. Mazzella	Ackenheil & Associates, Civil Engineer
L. Busack	Pennsylvania Department of Environmental Resources
P. Saunders	Pennsylvania Department of Environmental Resources
V. Paulsen	Owner's Representative

Recorder J. E. Barrick

GEO Project G80138-0
PennDER I.D. No. 10-63

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The vertical alignment of the crest appeared to be generally even. No depressions or irregularities were observed. The horizontal alignment of the embankment appeared to be in accordance with design conditions. There were no offsets, indications of misalignment or indications of post-construction alignment changes.	
RIPRAP FAILURES	None observed.	
SETTLEMENT	None observed.	

EMBANKMENT (CONTINUED)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT	The junction of the embankment and the right abutment contained a swampy zone in the reach immediately above the toe of the embankment. Seepage and water-related vegetation were observed in the general vicinity. The junction of the embankment and the left abutment gave no indication of seepage or swampy conditions. An animal burrow was observed near the crest of the embankment.	
JUNCTION OF EMBANKMENT AND EMERGENCY SPILLWAY	The junction of the embankment and the emergency spillway appeared to be in good condition. A swampy zone was observed in the spillway channel above the roadway embankment. The origin of the swampy condition could not be determined, but appeared to be the result of poor surface drainage. Below the roadway embankment, a swampy zone was observed extending down the spillway channel. The origin of this swampy condition could not be determined, but there was no strong evidence that it was due to seepage from the reservoir.	
ANY NOTICEABLE SEEPAGE	Seepage and swampy conditions were observed near the toe of the embankment in the vicinity of the principal spillway outlet structure. Two significant seeps were flowing at each side of the structure's wingwalls; both seeps showed considerable iron staining. Also, as described under Junction of Embankment and Abutment above, seepage and swampy conditions were observed in the lower right groin.	

EMBANKMENT (CONTINUED)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE (continued)	Several seeps and marshy conditions were noted on the creek bank along the downstream channel below the dam. A particularly strong spring was observed approximately 250 feet downstream of the embankment. The flow was estimated to be 20 to 25 gallons per minute and fine soil sediments were observed below the discharge point. Iron staining was observed at and below the spring discharge point. Discussion with the owner's representative revealed that the spring had existed prior to construction of the dam. Recently deposited fine soil sediments were observed in the creek at the confluence with spring flow.	
DRAINS	None observed.	
CONCRETE EROSION PROTECTION	The concrete slab-type erosion protection on the upstream face of the embankment was in generally good condition. Some minor cracking of individual slabs was observed and vegetation was growing in slab joints. Near the left end of the embankment, one slab had been displaced slightly downward and rotated, resulting in an enlarged joint opening.	

PRINCIPAL SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
INTAKE STRUCTURE	The principal spillway intake structure consists of a reinforced concrete drop inlet structure with two anti-vortex walls. The structure's plan cross-section is a 5 foot by 3.5 foot rectangle and inflow is by weir control over the two five foot walls. The opening of the intake structure is protected by a grill constructed of #8 reinforcing bars on six to eight inch centers. Access to the intake structure is via a walkway consisting of a 24 inch wide flange beam laid with the web horizontal.	
CONDUIT	The principal spillway conduit consists of a 16 inch diameter corrugated metal pipe which could not be inspected because of lack of access.	
OUTLET STRUCTURE	The principal spillway outlet structure consists of a concrete headwall with concrete wingwalls parallel to the conduit. The headwall and wingwalls were in good condition with no significant cracking or deterioration.	
OUTLET CHANNEL	The principal spillway outlet channel consists of a rocklined stilling pool immediately below the outlet structure. The rock lining was heavily overgrown with vegetation but appeared to be in good condition. Discharge from the stilling pool is to an unmaintained creek channel below the dam.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
INTAKE STRUCTURE	The outlet works intake structure consists of a slide gate located at the base of the upstream wall of the principal spillway intake structure. The gate is controlled by a handwheel at the end of the walkway beam atop the principal spillway. No handwheel was available for operation of the gate. The owner's representative indicated that the gate had been used two years ago to draw the lake down. At that time a diver inspected the submerged portion of the outlet works and reportedly found it in satisfactory condition.	

EMERGENCY SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
APPROACH CHANNEL	The emergency spillway approach channel was clear of debris and obstructions on the date of inspection.	
CONCRETE SILL	A concrete sill crosses the upper end of the emergency spillway channel. The top of this wall was in good condition.	
DISCHARGE CHANNEL	The emergency spillway discharge channel contains a major obstruction, approximately 250 feet below the reservoir. The obstruction is an embankment that carries the private road across the emergency spillway channel. Three 36 inch diameter CMP culvert pipes provide for partial spillway drainage. Two wet swampy areas were observed within the limits of the emergency spillway discharge channel. The origin of the water causing the swampy conditions could not be determined but there was no strong indication that it was seepage from the reservoir. The lower portion of the discharge channel has riprap lined sidewalls. The condition of the riprap was generally good, though in some places, it was overgrown with vegetation. At the lower end of the discharge channel, drainage from the wet, swampy area enters an erosional gully. The gully was 2 to 3 feet deep and contained considerable vegetation. No significant active erosion was observed in the gully.	
BRIDGE AND PIERS	None observed.	

INSTRUMENTATION

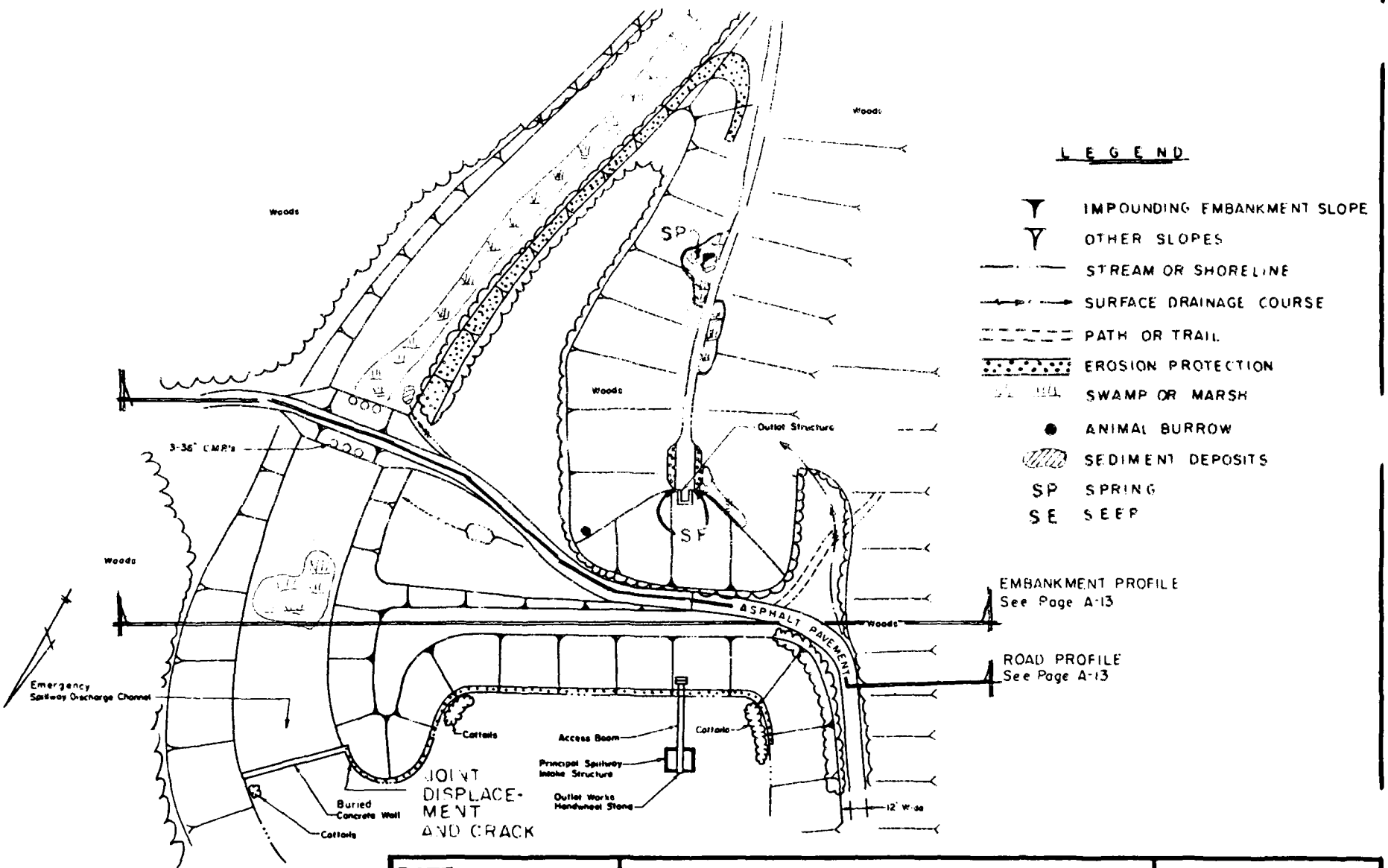
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed.	
OBSERVATION WELLS	None observed.	
WEIRS	Principal spillway intake structure weir walls could be used to approximately measure principal spillway discharge conditions.	
PIEZOMETERS	None observed.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Shoreline slopes around the reservoir were observed to be generally mild and lightly to moderately wooded. There were no indications of significant shoreline instability on the date of inspection.	
SEDIMENTATION	None observed.	
WATERSHED	The watershed was observed to be generally as indicated by the U.S.G.S. topographic map. No significant new construction or mining activities were observed in the watershed.	

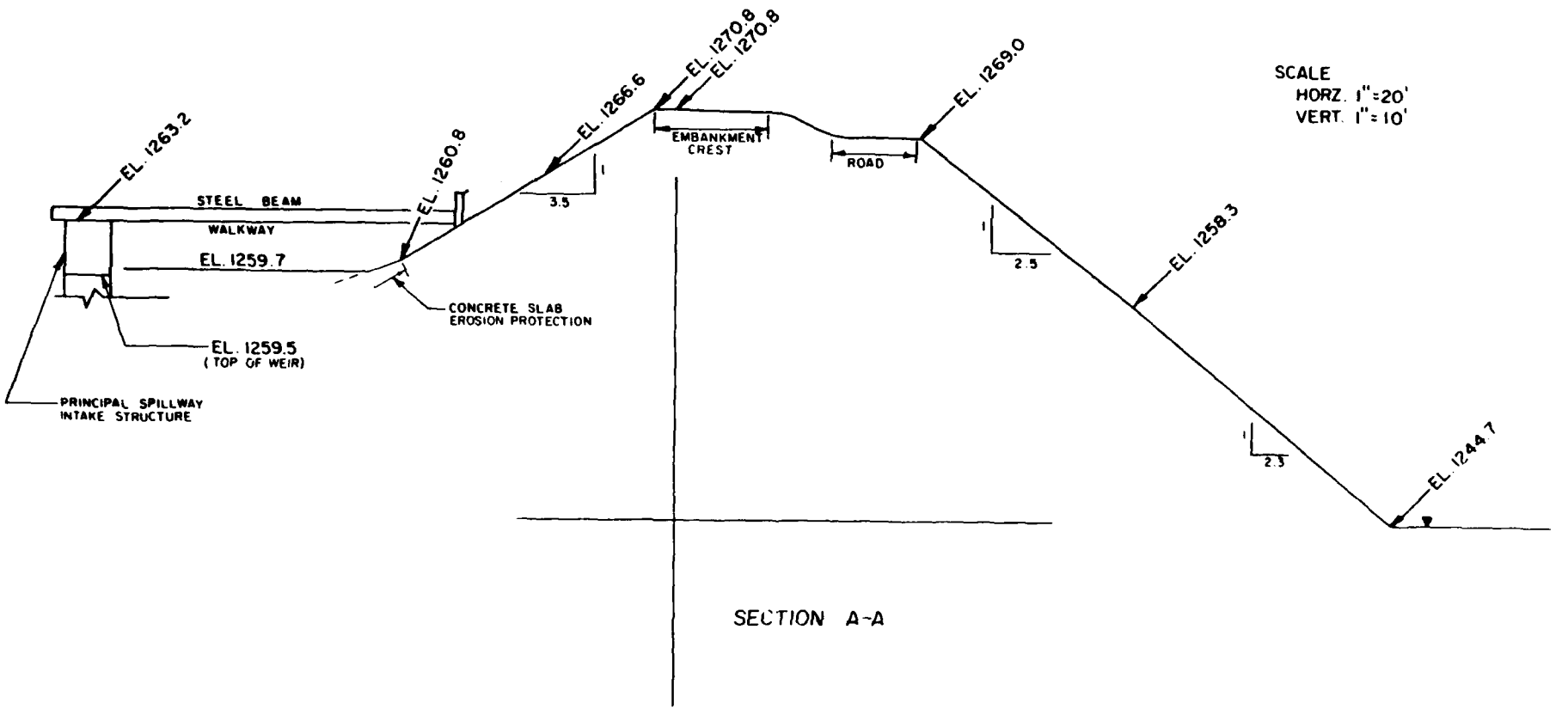
DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel below the principal spillway outlet is the original Sarver Run channel which is narrow, winding and overgrown with trees and underbrush. The creek valley is uninhabited for approximately 3,000 feet below the dam. Two miles below the dam, the village of Coal Hollow lies on the Sarver Run floodplain.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	In the first two miles below the dam there are at least nine inhabited dwellings located in the Sarver Run valley at elevations low enough to possibly be affected by high flows.	



A11

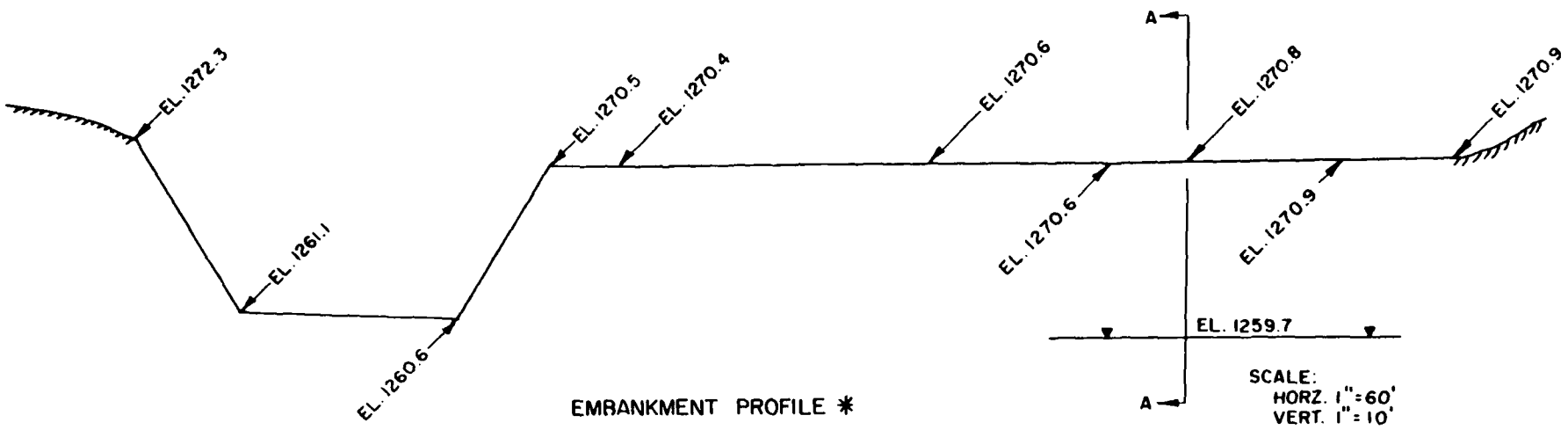
DATE: MAY 1981	LAKE SAXONY NATIONAL DAM INSPECTION PROGRAM	FIELD SKETCH
SCALE: NONE		
DR: JF CK: JEB	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS GEO SYSTEMS, INC. 1000 BANKSVILLE RD PITTSBURGH PA 15216	
DWG. NO. 801380-1		



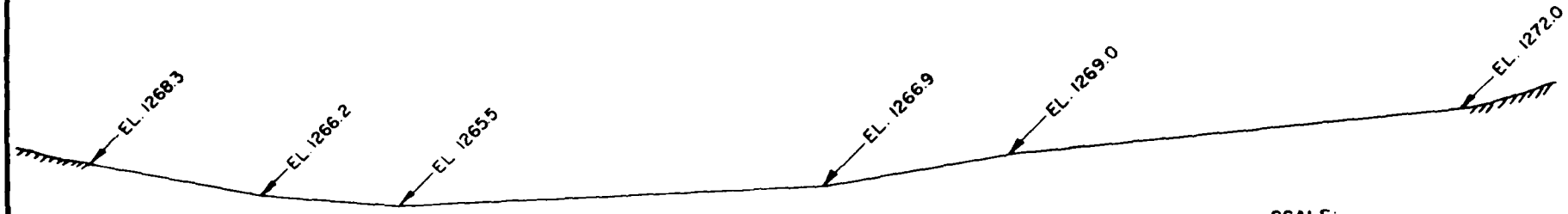
SECTION A-A

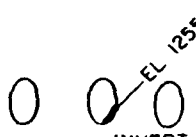
A12

DATE: MAY 1981	LAKE SAXONY DAM NATIONAL DAM INSPECTION PROGRAM	FIELD SECTION
SCALE: AS SHOWN		
DR: JF CK: JEB	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS GEO SYSTEMS, INC.	
DWG. NO. 801380-2	1000 BANKSVILLE RD. PITTSBURGH PA. 15216	



EMBANKMENT PROFILE *
(LOOKING DOWNSTREAM)





ROAD PROFILE *
(LOOKING DOWNSTREAM)

* SEE FIELD SKETCH, PAGE A 11

DATE: MAY 1981		LAKE SAXONY DAM NATIONAL DAM INSPECTION PROGRAM	FIELD PROFILES
SCALE: AS SHOWN			
DR: JF	CK: JEB	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS GEO SYSTEMS, INC. 1000 BANKSVILLE RD. / PITTSBURGH, PA. 15216	
DWG. NO. 801380-3			

A 13

APPENDIX B

ENGINEERING DATA CHECKLIST

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Lake Saxony Dam
NDI No. PA 01073

ITEM	REMARKS
*Design Drawings	Design drawings by Gilbert P. Fleetwood, P.E., dated June 1955, including: Sheet 1 of 3, Topography, Proposed Lake Saxony Farms, Butler Co., Pa., and Revised Sheet 1 of 3**. Sheet 2 of 3, Saxony Farms, Embankment and Spillway Plan and Revised Sheet 2 of 3**. Sheet 3 of 3, Proposed Dam, Saxony Farms, Profiles, Sections and Outlet Works Details, and Revised Sheet 3 of 3**.
As-Built Drawings	Drawings 2 of 3 and 3 of 3 above with penciled-in changes.
Regional Vicinity Map	U.S.G.S 7-1/2 minute Saxonburg and Curtisville Pennsylvania Quadrangle Maps.
*Construction History	Construction began in July 1956 and was completed in April 1958. The name of the contractor was not reported. Semi-monthly reports by the dam's owner to the state during construction indicate that excavation problems (sandstone) in the spillway hampered progress.

ITEM	REMARKS
*Typical Sections of Dam	Longitudinal and transverse sections, see Design Drawings.
*Outlets-Plan Details Constraints Discharge Ratings	See Design Drawings.
Rain/Reservoir Records	None reported.
*Design Reports	"Report Upon the Application of Saxony Farms", dated 29 June 1956, prepared by the Chief Engineer, Division of Dams, for the Water and Power Resources Board.
Geology Reports	None available.
Design Computations	None available.
Hydrology and Hydraulics	None available.
Dam Stability	None available.
Seepage Studies	None available.
Materials Investigations, Borings Records, Laboratory, Field	None available.

ITEM	REMARKS
Post-Construction Surveys of Dam	None reported.
*Borrow Sources	Construction Progress Report references to excavation in impoundment zone.
Monitoring Systems	None reported.
*Modifications	The major modifications performed during construction were: 1. Upstream and downstream slopes changed from 3H:1V to 2.5H:1V. 2. Crest width from 20 feet to 35 feet. 3. Slopes in the emergency spillway channel from 3H:1V to 3.5H:1V. 4. Rock riprap on upstream face to concrete slab erosion protection. 5. 8 inch "I" beams for gate structure bridge to 24 inch "I" beam. 6. Pipe and cable railing added to bridge. 7. Concrete cutoff wall added in the emergency spillway channel. 8. Dam and spillway configuration changed to reduce rock excavation.
High Pool Records	None available.

ITEM	REMARKS
Post-Construction Engineering Studies and Reports	None available.
Maintenance, Operation, Records	None available.
*Spillway-Plan Sections Details	See Design Drawings above.
*Operating Equipment Plans and Details	See Design Drawings above.
Specifications	None available.
*Miscellaneous	One inspection report by the Board of Water Resources personnel dated 7 August 1967.
*Construction Reports	Nineteen progress reports by the owner to the Water and Power Resources Board between 15 August 1957 and 16 December 1957. "Report Upon the Request of Saxony Farms, for an Extension of Time: To Construct a Dam Across Sarver Run. . ." dated 4 December 1957 submitted to the Water and Power Resources Board.
Prior Accidents or Failure of Dam Description Reports	None available.

*Information and data may be obtained from the PennDER, Harrisburg, Pennsylvania.
**Reduced size reproductions contained in Appendix E.

APPENDIX C

PHOTOGRAPHS

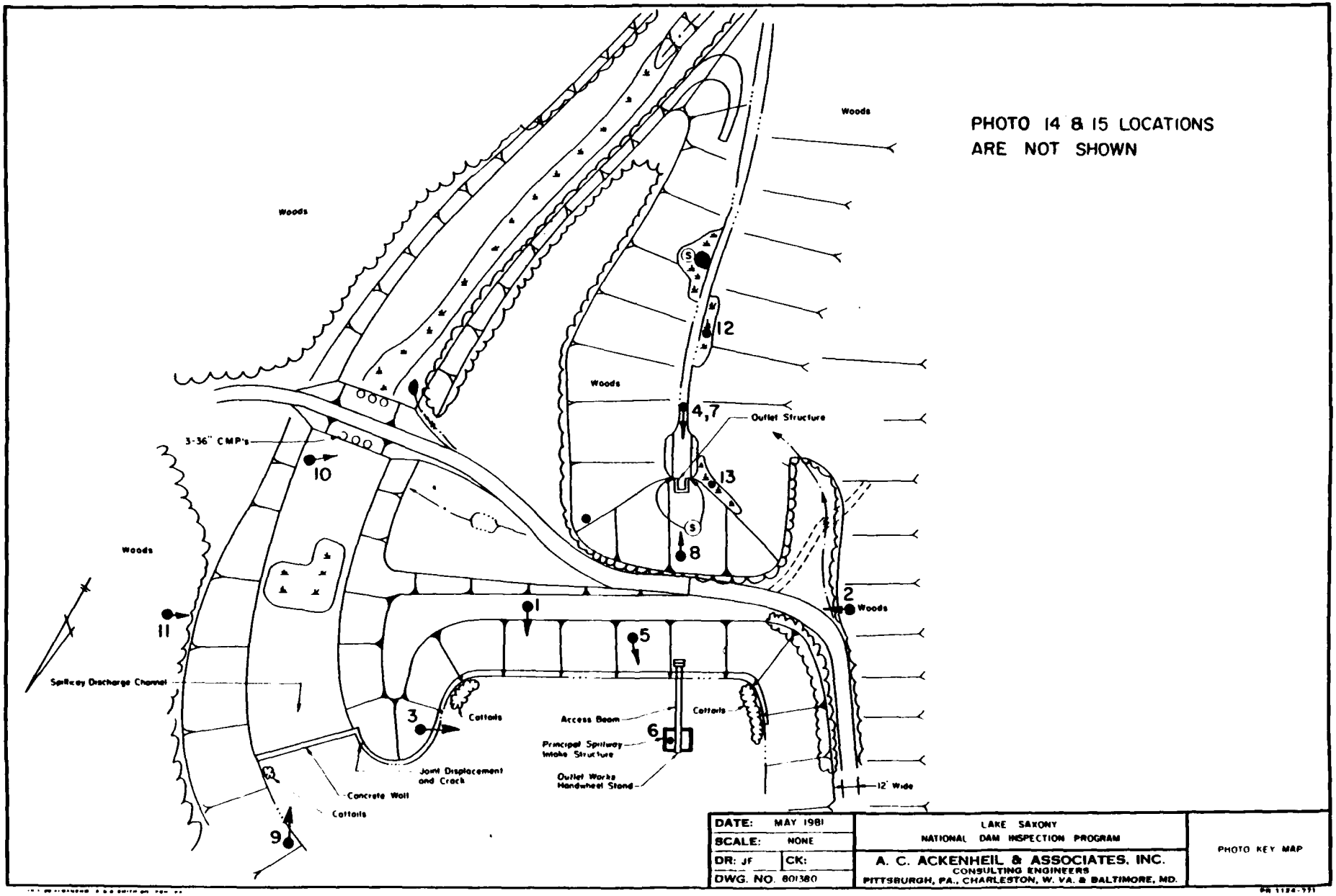

Woods
Woods
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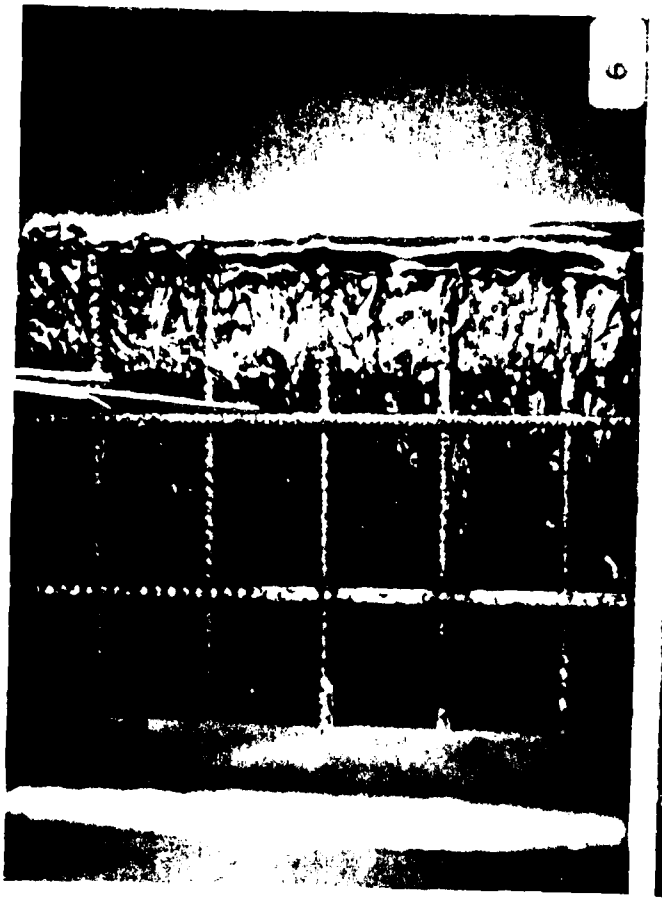
PHOTO 14 & 15 LOCATIONS
ARE NOT SHOWN
12
4,7
Outlet Structure
3-36" CMP's
10
13
8
11
1
2
5
Spillway Discharge Channel
3
Cattails
Access Beam
Cattails
6
Principal Spillway
Intake Structure
Joint Displacement
and Crack
Outlet Works
Handwheel Stand
Concrete Wall
12' Wide
Cattails
9
DATE: MAY 1981
SCALE: NONE
DR: JF
CK:
DWG. NO. 601380
LAKE SAXONY
NATIONAL DAM INSPECTION PROGRAM
A. C. ACKENHEIL & ASSOCIATES, INC.
CONSULTING ENGINEERS
PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.
PHOTO KEY MAP

LAKE SAXONY DAM

LAKE SAXONY DAM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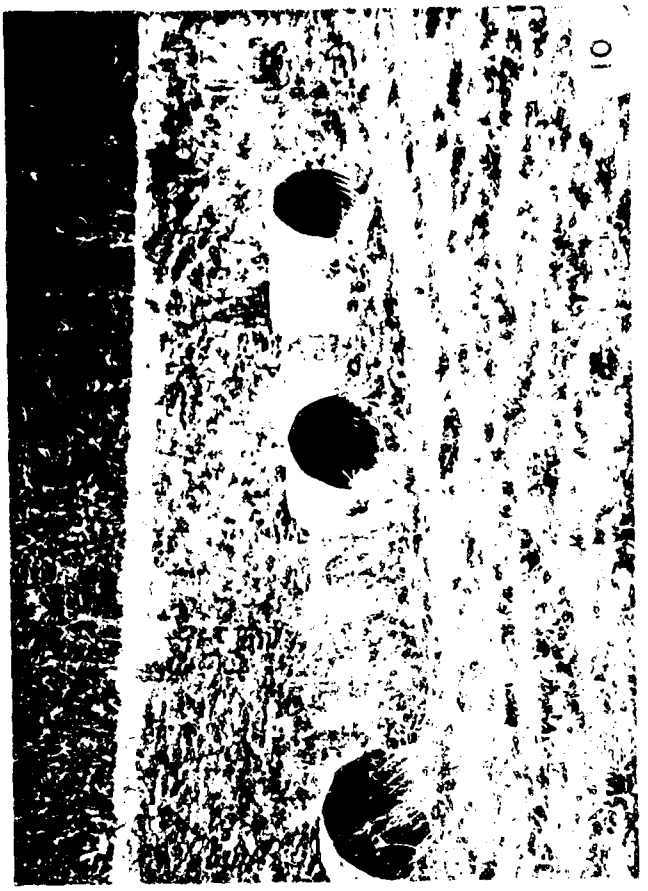
LAKE SAXONY DAM



LAKE SAXONY DAM

PHOTO DESCRIPTIONS

Photo 1 Reservoir Overview from embankment crest.

Photo 2 Embankment Crest and Road from right abutment.

Photo 3 Upstream Slope and Concrete Erosion Protection. Note grass between concrete slabs and principal spillway access bridge (center).

Photo 4 Downstream Slope. Principal spillway outlet structure concrete headwall at bottom of photo.

Photo 5 Principal Spillway Intake Structure and Access Bridge. Note absence of handwheel on gate valve stand.

Photo 6 Principal Spillway Flow Control Weir and Trash Rack.

Photo 7 Principal Spillway Outlet Structure.

Photo 8 Principal Spillway Discharge Channel.

Photo 9 Emergency Spillway Entrance. Note roadway embankment and 36 inch CMP conduits in background.

Photo 10 Close-up of 36 inch CMP Conduits and Roadway Embankment.

Photo 11 Overview of Emergency Spillway Discharge Channel. Note wet area in center of channel.

Photo 12 Spring with Sediments approximately 250 feet downstream of embankment toe.

Photo 13 Wet Zone near embankment toe.

Photo 14 Downstream Hazard. Bridge crosses Sarver Run.

Photo 15 Downstream Hazard. House is approximately 50 feet from bridge.

APPENDIX D

HYDROLOGY AND HYDRAULICS ANALYSES

APPENDIX D
HYDROLOGY AND HYDRAULICS
ANALYSES

Methodology: The dam overtopping analysis was accomplished using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation: The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydro-meteorological Report No. 33" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph: The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters, their definition and how they were obtained for these analyses.

Parameter	Definition	Where Obtained
Ct	Coefficient representing variations of watershed	From Corps of Engineers*
L	Length of main stream channel	From U.S.G.S. 7.5 minute topographic map
Lca	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic map
Cp	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 7.5 minute topographic map

3. Routing: Reservoir routing is accomplished by using Modified Puls routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation-discharge relationship.

Storage in the pool area is defined by an area-elevation relationship from which the computer calculates storage. Surface areas are either planimetered from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Spillway Evaluation Procedure: The emergency spillway was evaluated by initially assuming hydraulic control at:

Case I- the emergency spillway overflow crest, and

Case II- the roadway embankment.

Stage-discharge data for each hydraulic control condition were developed.

For Case II, the 36 inch CMP pipes were assumed to be blocked.

Examination of the data indicated that the roadway embankment would control the reservoir pool level for the assumed conditions. HEC-1 computer output is presented for Case II.

5. Dam Overtopping: Using given percentages of the Probable Maximum Flood (runoff from the PMP) the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

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*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Predominatly farmland and pasture: some residential development and woodland.

ELEVATION-TOP NORMAL POOL (STORAGE CAPACITY): 1259.5 (45 acre-feet)

ELEVATION-TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1270.4 (low point) (320 acre-feet)

ELEVATION-MAXIMUM DESIGN POOL: 1259.5

ELEVATION-TOP DAM: 1270.6 (average) 1270.4 (minimum)

OVERFLOW SECTION-SPILLWAY

a. Elevation 1260.9 (average)
b. Type Grass-lined, trapezoidal channel broad crested weir
c. Width 84.5 feet (base)
d. Length N/A
e. Location Spillover Left abutment
f. Number and Type of Gates None

OUTLET WORKS-EMBANKMENT

a. Type 16 inch CMP (concrete encased)
b. Location At centerline of dam (valley bottom)
c. Entrance Invert 1246
d. Exit Invert 1245
e. Emergency Drawdown Facilities 18 inch by 18 inch slide gate at intake well

OVERFLOW SECTION-ROADWAY

a. Elevation Varies - 1265.5 (minimum)
b. Type Broad crested weir
c. Width Approximately 540 feet
d. Length Approximately 15 feet
e. Location Spillover Left abutment in Emergency Spillway Discharge Channel
f. Number and Type of Gates None

OUTLET WORKS-ROADWAY

a. Type 3 - 36 inch CMP's
b. Location Through roadway embankment
c. Entrance Invert 1255.7
d. Exit Invert Unknown
e. Emergency Drawdown Facilities None

HYDROMETEOROLOGICAL GAGES

a. Type None
b. Location N/A
c. Records None

MAXIMUM REPORTED NON-DAMAGING DISCHARGE None reported

HEC-1 DAM SAFETY VERSION
HYDROLOGY AND HYDRAULIC ANALYSES
DATA BASE

NAME OF DAM: Lake Saxony Dam	NDI ID NO. PA 01073
Probable Maximum Precipitation (PMP)	23.9*
Drainage Area	1.1 sq. mi.
Reduction of PMP Rainfall for Data Fit	0.8 (23.9)
Reduce by 20%, therefore PMP rainfall	=19.1 inches
Adjustments of PMF for Drainage Area (Zone 7)	
6 hrs.	102.0%
12 hrs.	120.0%
24 hrs.	130.0%
48 hrs.	140.0%
Snyder Unit Hydrograph Parameters	
Zone	24**
C_p	0.45
C_t	1.6
L	1.7 mile
L_{ca}	0.8 mile
$t_p = C_t (L \cdot L_{ca})^{0.3}$ =	1.75 hours
Loss Rates	
Initial Loss	1.0 inch
Constant Loss Rate	0.05 inch/hour
Base Flow Generation Parameters	
Flow at Start of Storm	1.5 cfs/sq.mi=1.65 cfs
Base Flow Cutoff	0.05 x Q peak
Recession Ratio	2.0
Emergency Spillway Overflow Section Data	
Crest Length	84.5 feet
Freeboard (average)	9.6 feet
Side Slopes	3.5H:1V
Exponent	1.5
Coefficient	3.09
Discharge Capacity	10,350± cfs
Roadway Overflow Section Data	
Crest Length	540+ feet
Side Slopes	N/A
Exponent	1.5
Coefficient	3.09
Discharge Capacity	3,480+ cfs

---

* Hydrometerological Report 33
**Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients (C_p and C_t).

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Job LAKE SAXONY DAM Job No 80132.0
Subject DATA INPUT
Made By JPH Date 11/19/80 Checked JEB Date 4/14/81

LOSS RATE AND BASE FLOW PARAMETERS

As recommended by Corps of Engineers, BALTIMORE District

STRTL = 1 inch
CNSTL = 0.05 in/hr
STRTQ = 1.5 cfs/mi^2
QRCSN = 0.05 (5% of PEAK FLOW)
RTIOR = 2.0

ELEVATION - AREA - CAPACITY RELATIONSHIPS

FROM USGS 7.5 MIN QUAD, PENNDER FILES AND FIELD INSPECTION DATA.

AT ELEVATION 1260.0

INITIAL STORAGE = 44.8 ACRE-FT.

POND SURFACE AREA = 10.4 ACRES

AT ELEVATION 1280 AREA = 103.8 ACRES

FROM CONIC METHOD OF RESERVOIR VOLUME

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION (USERS MANUAL)

$$H = \frac{3V}{A} \qquad \frac{3(44.8)}{10.4} = 12.9 \text{ feet}$$

ELEVATION WHERE AREA EQUALS ZERO
1260.0 - 12.9 = 1247.1

$A	0.	10.4	103.8
$E	1247.1	1260.0	1280.0

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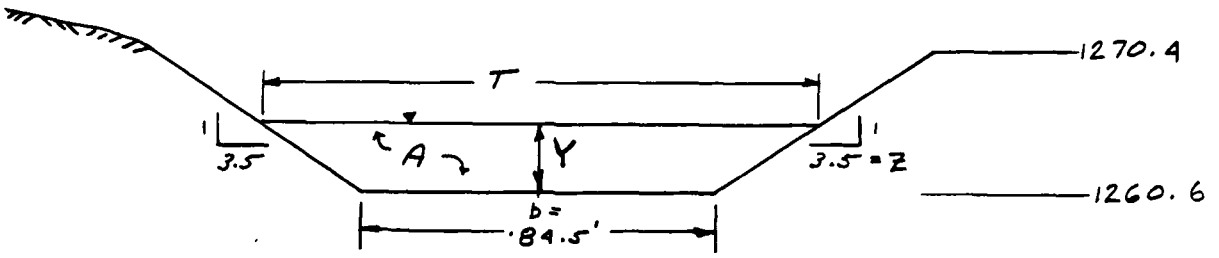
Job LAKE SAXONY DAM Job No 80138-0
Subject SPILLWAY DISCHARGE (CASE I)
Made By SGM Date 2 MAR. 81 Checked JEB Date 4/14/81

FLOW CONTROL AT EMERGENCY SPILLWAY ENTRANCE

(CASE I)



$A = (b + zy)\,y = (84.5 + 3.5y)\,y$

$T = b + 2zy = (84.5 + 7y)$

D = (HYDRAULIC MEAN DEPTH) $= A / T$

ASSUMING CRITICAL DEPTH

$$\frac{Q^2}{g} = \frac{A^3}{T}$$

$$Q = \left(\frac{A^3 g}{T}\right)^{1/2}$$

$$H_E = y + \frac{D}{2}$$

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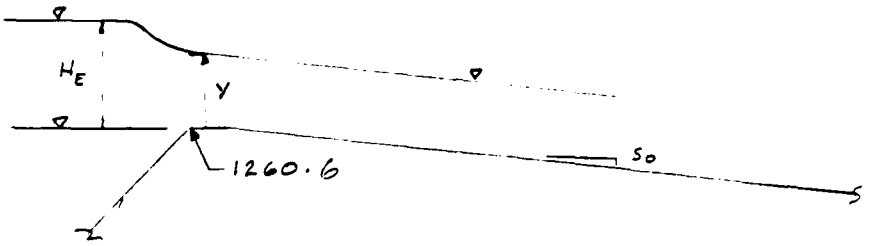
Job LAKE SAXONY DAM Job No 80139-0

Subject SPILLWAY DISCHARGE - CASE I

Made By SGM Date 27 APR 81 Checked [illegible] Date 4-28-81



* - POOL ELEVATION IS ABOVE EMBANKMENT CREST

$$H_E = Y + D/2$$

ELEV. (FT)	Y (FT)	A (FT^2)	T (FT)	D (FT)	Q (CFS)	H_E (FT)	POOL ELEV. 1260.6 + H_E
1260.6	0	0	0	0	0	0	1260.6
1261.6	1	88.0	91.5	0.96	489.7	1.48	1262.1
1262.6	2	183.0	98.5	1.86	1,415.4	2.93	1263.5
1263.6	3	285.0	105.5	2.70	2,658.1	4.35	1265.0
1264.6	4	394.0	112.5	3.50	4,184.0	5.75	1266.4
1265.6	5	510.0	119.5	4.27	5978.6	7.14	1267.7
1266.6	6	633.0	126.5	5.00	8,035.0	8.50	1269.1
1267.6	7	763.0	133.5	5.72	10,350.8	9.86	1270.5
1268.6	8	900.0	140.5	6.41	12,925.7	11.21	1271.9

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Job LAKE SAXONY DAM Job No 80138-0
Subject SPILLWAY DISCHARGE (CASE II)
Made By SGM Date 3MAR.81 Checked JEB Date 4/4/81

FLOW CONTROL AT ROADWAY EMBANKMENT (CASE II)

FOR SKETCH, SEE NEXT PAGE :

T IS MEASURED FROM SKETCH

$$A_{TRIANGULAR} = \tfrac{1}{2} a Y + \tfrac{1}{2} b Y = \tfrac{1}{2} Y (a + b)$$
$$= \tfrac{1}{2} \Delta Y_i T_i$$

$$A_{TRAPEZOIDAL} = \tfrac{1}{2} \Delta Y_{i+1} [T_i + T_{i-1}]$$

$$D_i = \Sigma A_i / T_i$$

$$\frac{Q_i^2}{g} = \left(\frac{\Sigma A_i}{T_i}\right)^3$$

$$Q_i = \left[\left(\frac{\Sigma A_i^3}{T_i}\right) \times g\right]^{1/2}$$

$$H_E = \Sigma \Delta Y_i + \frac{D_i}{2}$$

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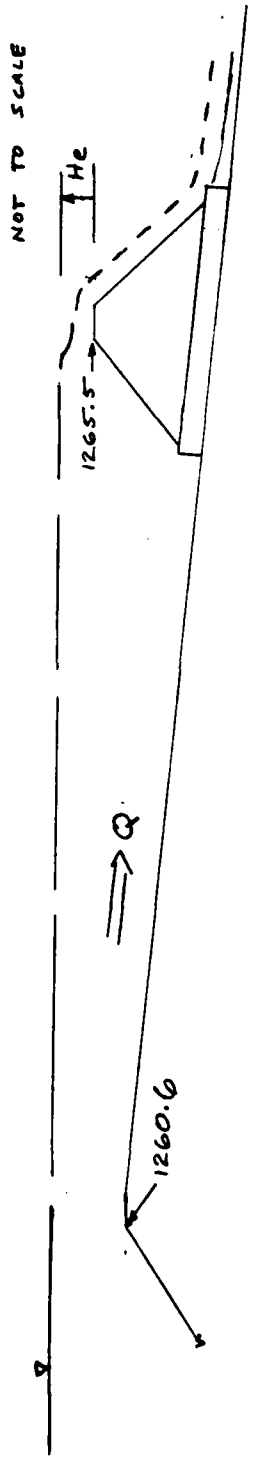
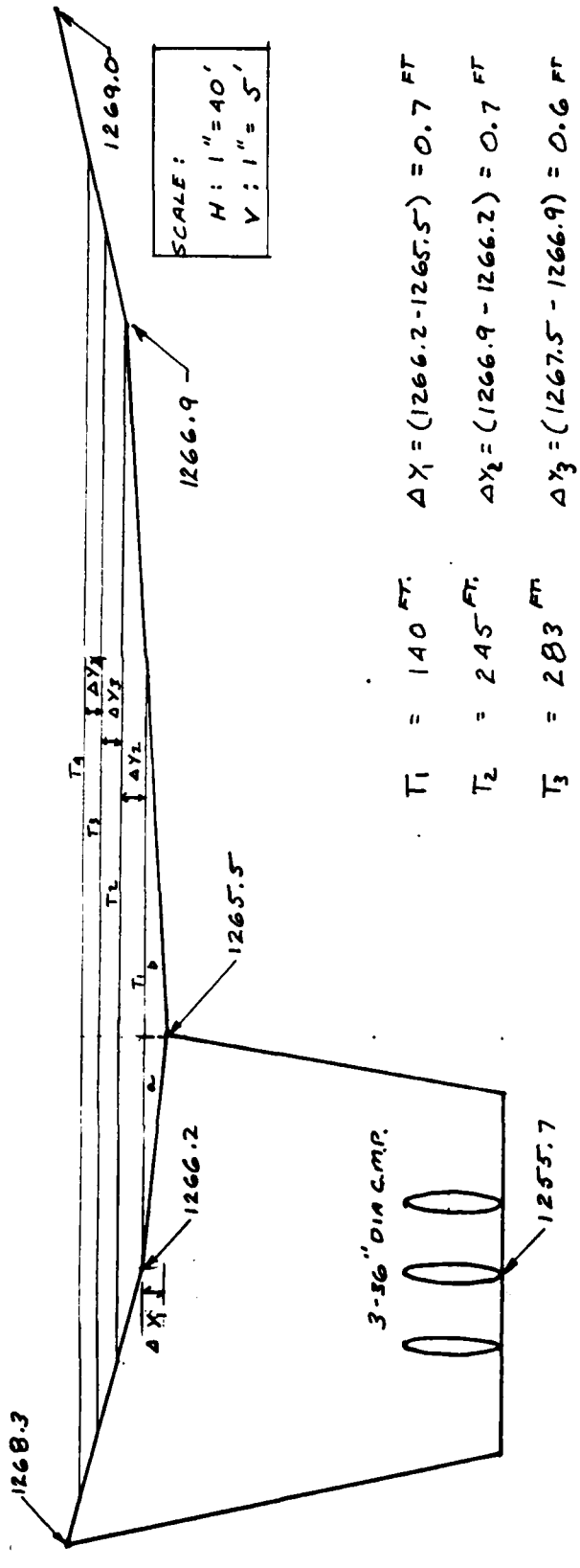
Job LAKE SAXONY DAM Job No 80138-0

Subject SPILLWAY DISCHARGE - CASE II

Made By SGM Date 3 MAR. 81 Checked JEB Date 4/6/81





$\Delta Y_1 = (1266.2 - 1265.5') = 0.7$ FT

$\Delta Y_2 = (1266.9 - 1266.2) = 0.7$ FT

$\Delta Y_3 = (1267.5 - 1266.9) = 0.6$ FT

$\Delta Y_4 = (1268.0 - 1267.5) = 0.5$ FT

$T_1 = 140$ FT.

$T_2 = 245$ FT.

$T_3 = 283$ FT

$T_4 = 317$ FT.

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Job LAKE SAXONY DAM Job No 80138-0

Subject SPILLWAY DISCHARGE - CASE II

Made By SGM Date 3 MAR 81 Checked JEB Date 4/14/81

ELEV. (FT.)	ΔY (FT)	T (FT)	A_i (FT^2)	ΣA (FT^2)	Q (CFS)	D (FT)	H_E (FT)	CHANNEL POOL ELEV. 1265.5 + H_E
1265.5	0	0	0	0	0	0	0	1265.5
1266.2	0.7	140	49.0	49.0	164.5	0.35	0.88	1266.4
1266.9	0.7	245	134.75	183.75	903.0	0.75	1.78	1267.3
1267.5	0.6	283	158.4	342.15	2134.8	1.21	2.61	1268.1
1268.0	0.5	317	150.0	492.15	3480	1.55	3.28	1268.8

FOR CASE II:

POOL $\simeq$ 1269 , Q = 3480 CFS

FOR CASE I:

POOL $\simeq$ 1269 , Q = 8035 CFS

$\therefore$ ROADWAY EMBANKMENT (CASE II) CONTROLS RESERVOIR POOL LEVEL.

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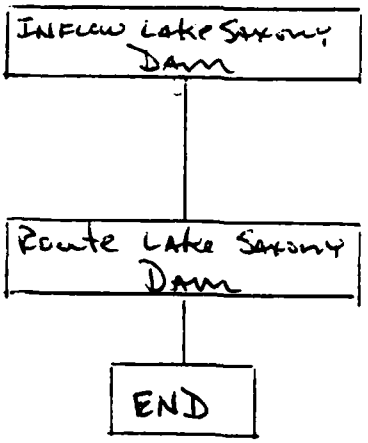
Job Lake Saxony Dam Job No 80138-C
Subject Data Input
Made By JPH Date 11/19/80 Checked JEB Date 4/14/81

Overtop Parameters

Top of Dam Elevation (LOW POINT) = 1270.4
Length of Dam (excluding Spillway) = 350
Coefficient of Discharge = 3.09

Program Schedule



```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1              A1       NATIONAL PROGRAM FOR THE INSPECTION OF NON FEDERAL DAMS
    2              A2       HYDROLOGIC AND HYDRAULIC ANALYSIS OF LAKE SAXONY DAM
    3              A3       PROBABLE MAXIMUM FLOOD PMF/UNIT HYDROGRAPH BY SNYDER'S METHOD
    4              B    300       0      15       0       0       0       0       0      -4       0
    5              B1     5
    6              J      1       2       1
    7              J1    1.     0.5
    8              K      0       1                                               1
    9              K1       INFLOW HYDROGRAPH FOR LAKE SAXONY DAM
   10              M      1       1     1.1             1.1                                      1
   11              P             23.9     102     120     130     140
   12              T                                                       1.0     .05
   13              W   1.75     0.45
   14              X   -1.5    -0.05     2.0
   15              K      1       2                                               1
   16              K1       ROUTING AT LAKE SAXONY DAM
   17              Y                                      1       1
   18              Y1     1                                                 44.8      -1
   19              Y41265.5   1266.4  1267.3  1268.1  1268.8
   20              Y5     0.    165.0   903.0  2135.0  3480.0
   21              $A     0.    10.4    104.2
   22              $E1247.1   1260.0  1280.
   23              $$1265.5
   24              $D1270.4    3.09     1.5    350.
   25              K     99
   26              A
   27              A
   28              A
   29              A
   30              A

                        PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                                RUNOFF HYDROGRAPH AT          1
                                ROUTE HYDROGRAPH TO           2
                                END OF NETWORK

**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN  DATE:  1 MAY 81
RUN  TIME: 10.32. 5


                        NATIONAL PROGRAM FOR THE INSPECTION OF NON FEDERAL DAMS
                        HYDROLOGIC AND HYDRAULIC ANALYSIS OF LAKE SAXONY DAM
                        PROBABLE MAXIMUM FLOOD PMF/UNIT HYDROGRAPH BY SNYDER'S METHOD

                                        JOB SPECIFICATION
          NQ      NHR      NMIN     IDAY      IHR      IMIN     METRC     IPLT     IPRT     NSTAN
         300        0        15        0        0        0         0        0       -4         0
                                    JOPER      NWT    LROPT    TRACE
                                        5        3        0        0


                                MULTI-PLAN ANALYSES TO BE PERFORMED
                                    NPLAN= 1 NRTIO= 2 LRTIO= 1
                    RTIOS=    1.00    0.50

**********      **********      **********      **********      **********
```

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH FOR LAKE SAXONY DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.10	0.0	1.10	0.0	0.0	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	23.90	102.00	120.00	130.00	140.00	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.05	0.0	0.0

UNIT HYDROGRAPH DATA

TP= 1.75 CP=0.45 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH 63 END-OF-PERIOD ORDINATES, LAG= 1.76 HOURS, CP= 0.45 VOL= 1.00

6.	32.	65.	103.	140.	168.	184.	183.	170.	155.
141.	129.	118.	108.	98.	90.	82.	75.	68.	62.
57.	52.	48.	43.	40.	36.	33.	30.	28.	25.
23.	21.	19.	18.	16.	15.	13.	12.	11.	10.
9.	8.	8.	7.	6.	6.	5.	5.	4.	4.
4.	3.	3.	3.	3.	2.	2.	2.	2.	2.
2.	1.	1.							

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	26.77	24.35	2.42	69469.
										(680.)(618.)(61.)(1967.15)			

********** *********** ********** ********* **********

HYDROGRAPH ROUTING

ROUTING AT LAKE SAXONY DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.0	0.0	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	45.	-1

STAGE	1265.50	1266.40	1267.30	1268.10	1268.80
FLOW	0.0	165.00	903.00	2135.00	3480.00
SURFACE AREA=	0.	10.	104.		
CAPACITY=	0.	45.	1028.		
ELEVATION=	1247.	1260.	1280.		

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1265.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1270.4	3.1	1.5	350.

PEAK OUTFLOW IS 2351. AT TIME 41.75 HOURS

PEAK OUTFLOW IS 1170. AT TIME 41.75 HOURS

********** *********** ********** ********* **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	 RATIO 2 0.50
HYDROGRAPH AT	1	1.10	1	2381.	1191.
	(	2.85)	(	67.43)(	33.71)(
ROUTED TO	2	1.10	1	2351.	1170.
	(	2.85)	(	66.58)(	33.13)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	ROADWAY CREST	TOP OF DAM
ELEVATION	1260.00	1265.50	1270.40
STORAGE	45.	143.	320.
OUTFLOW	0.	0.	6554.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1268.21	0.0	229.	2351.	0.0	41.75	0.0
0.50	1267.47	0.0	202.	1170.	0.0	41.75	0.0

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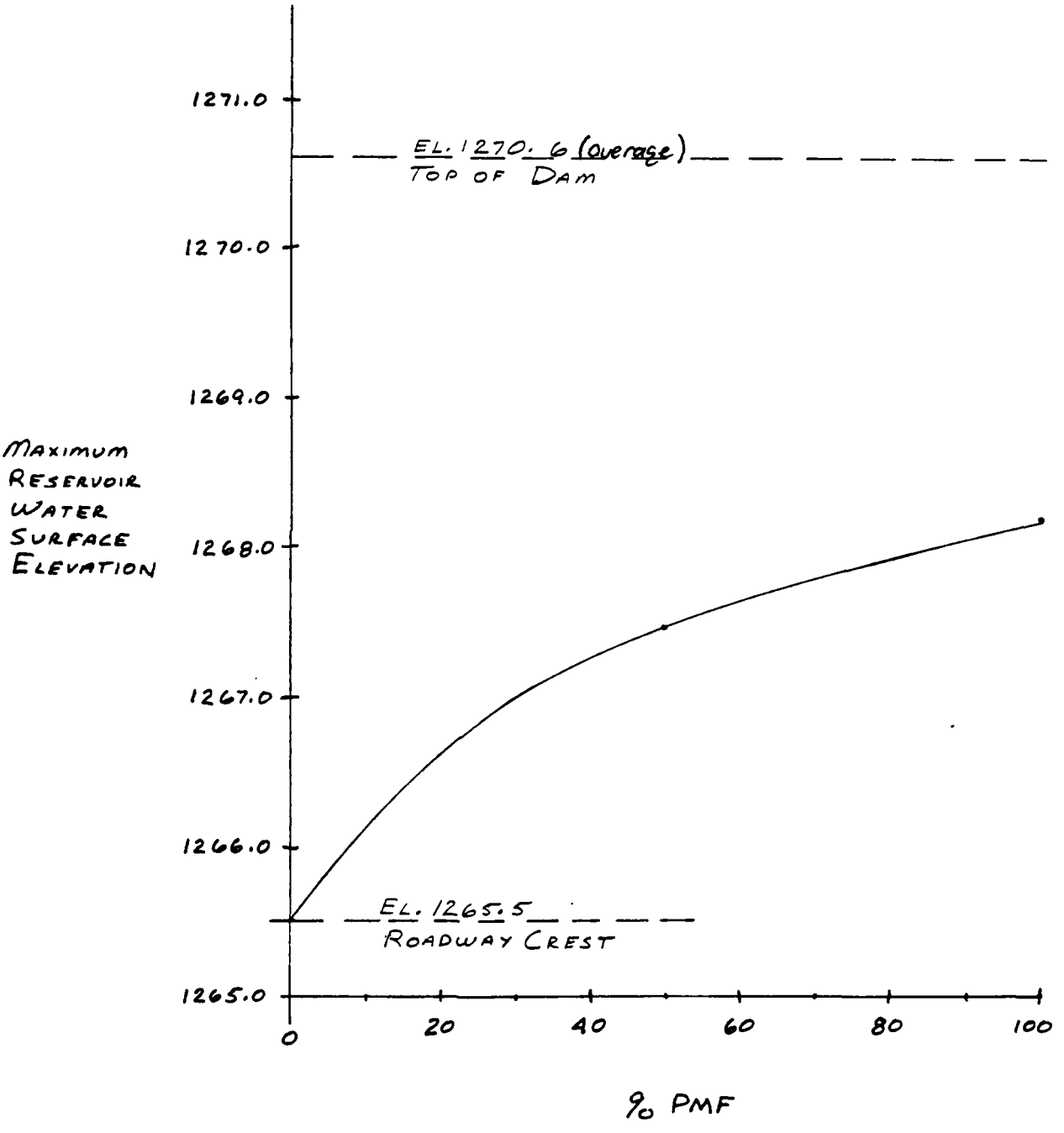
Job LAKE SAXONY DAM Job No 80138-0

Subject HYDROLOGIC PERFORMANCE PLOT

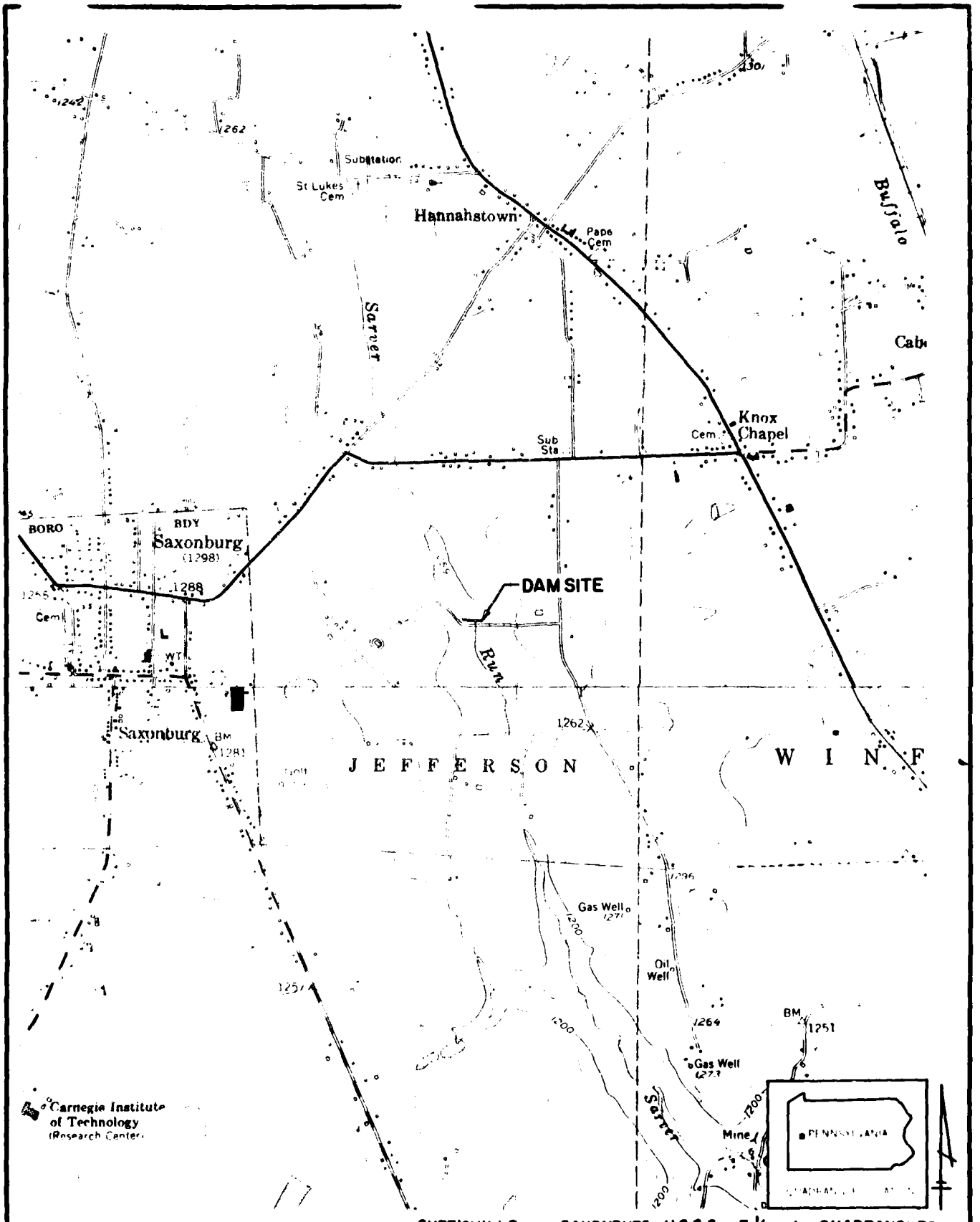
Made By SGM Date 16 APR. 81 Checked JEB Date 4/20/81



APPENDIX E

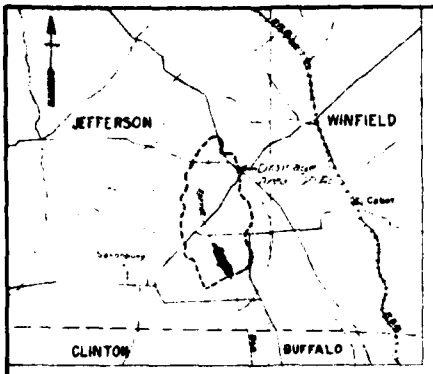
PLATES

LIST OF PLATES



CURTISVILLE and SAXONBURG U.S.G.S. 7 1/2 min. QUADRANGLES

DATE. MAY 1981	LAKE SAXONY DAM NATIONAL DAM INSPECTION PROGRAM	REGIONAL VICINITY MAP
SCALE: 1" = 2000'		
DR: JF CK:	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS GEO SYSTEMS, INC. 1000 BANKSVILLE RD./PITTSBURGH, PA 15216	
PLATE I		



VICINITY MAP

Magnetic North

Reservoir Full Pool El. 1260.2

Match Line

1260

1256

1254

1252

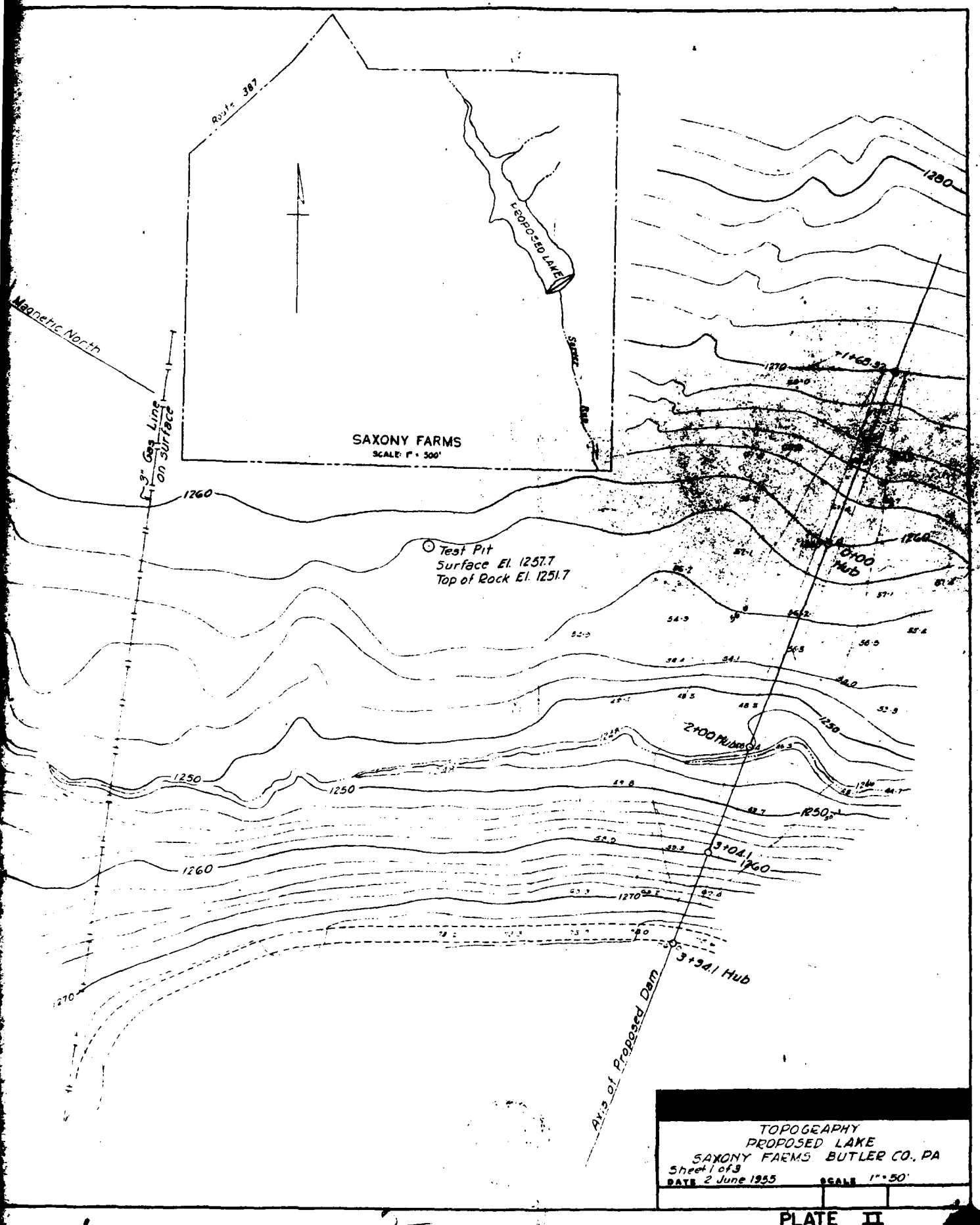
1250

1258

Abandoned Well
Top of Casing 1261.0

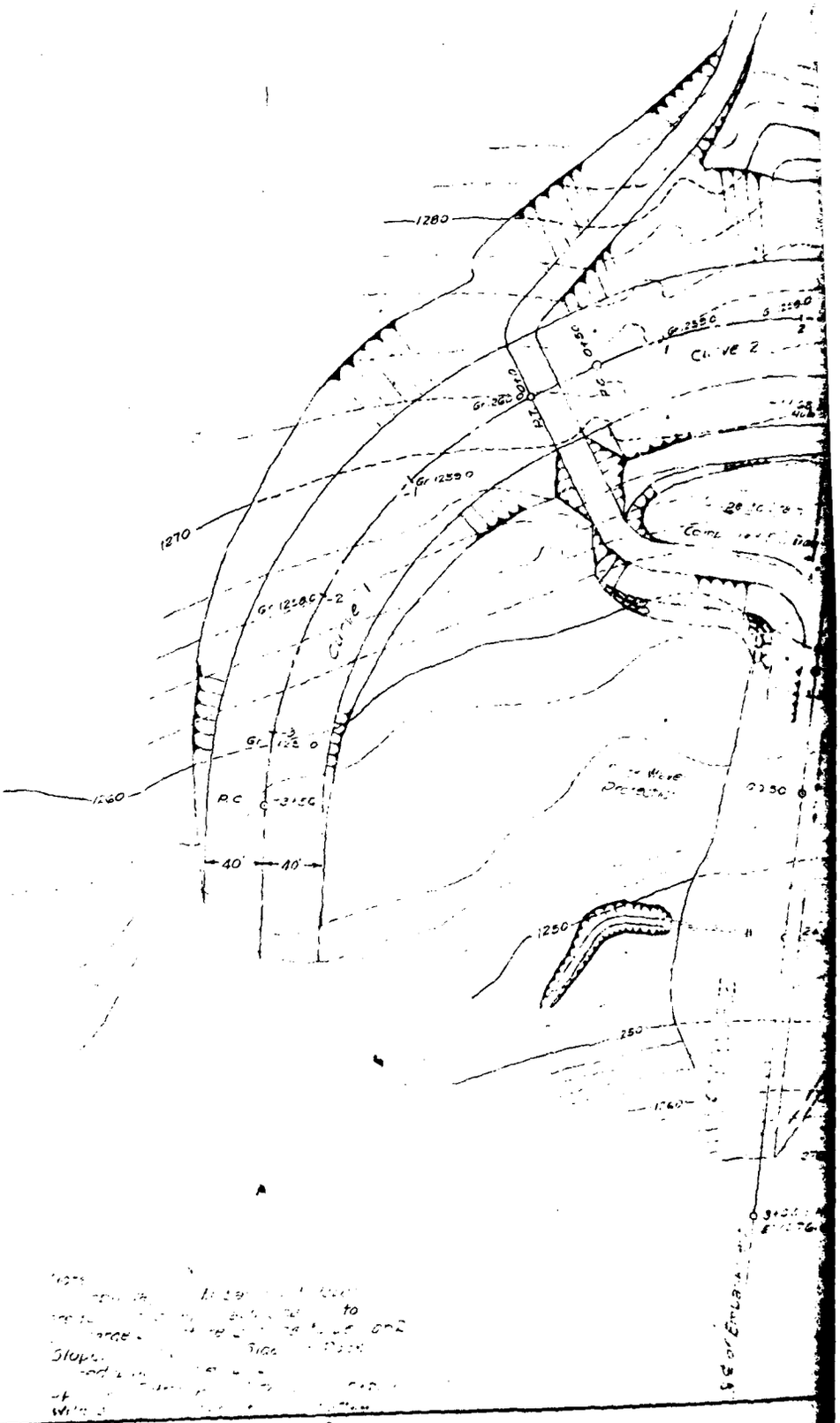
Match Line

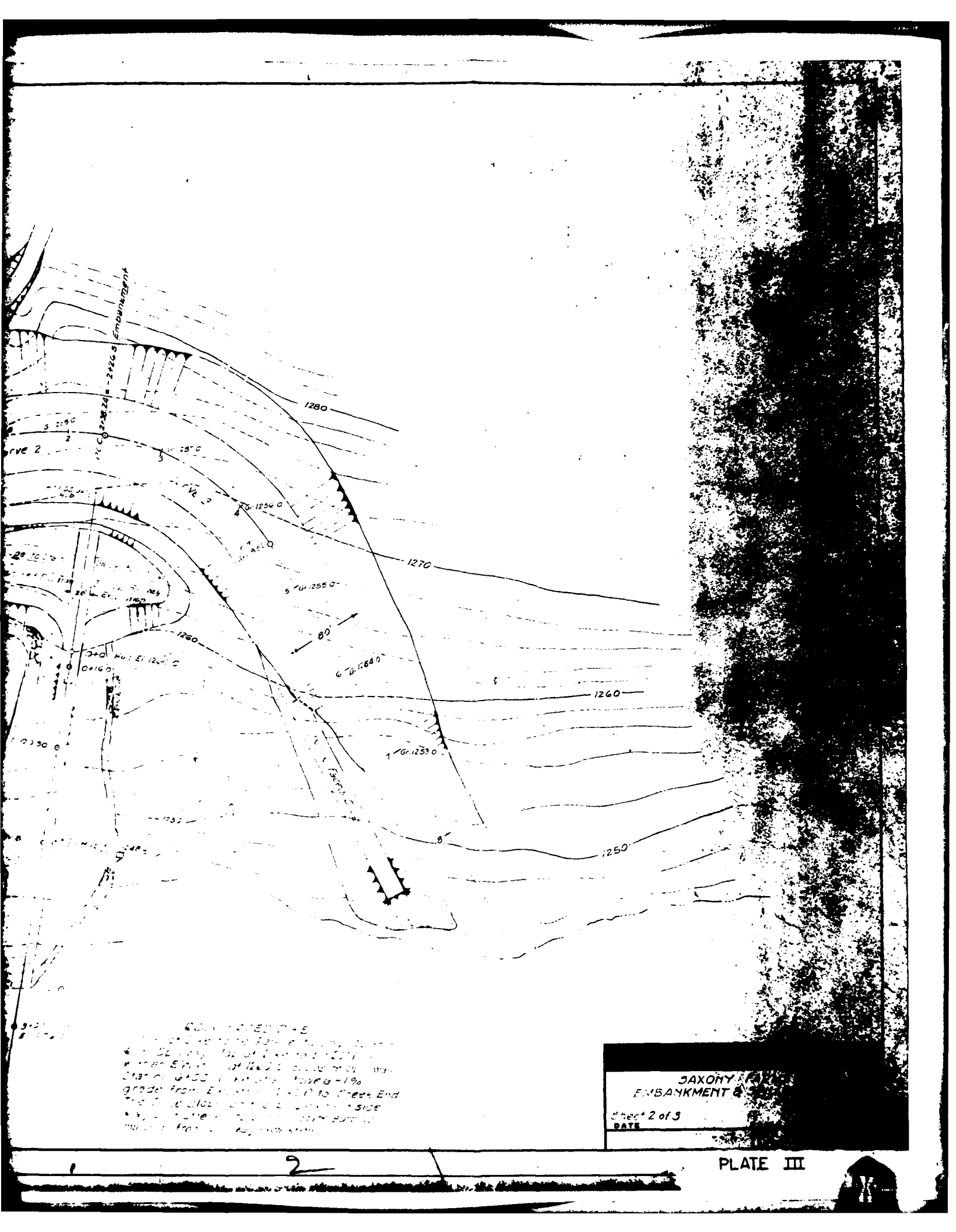
Reservoir Area 10.4 ± Acres
Reservoir Capacity 44.9 ± Acre Feet



TOPOGRAPHY
PROPOSED LAKE
SAXONY FARMS BUTLER CO., PA
Sheet 1 of 3
DATE 2 June 1955 SCALE 1" = 50'

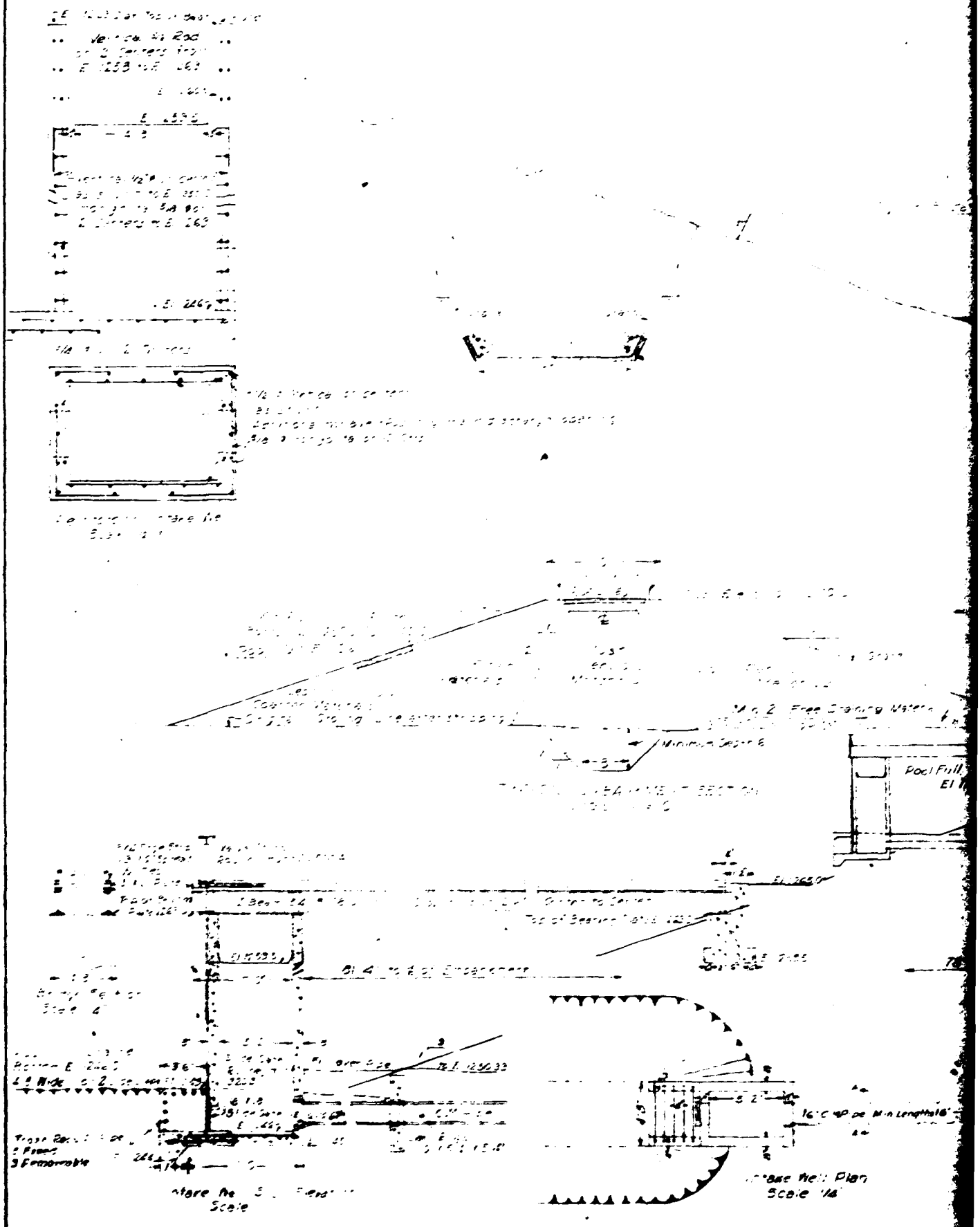
PLATE II

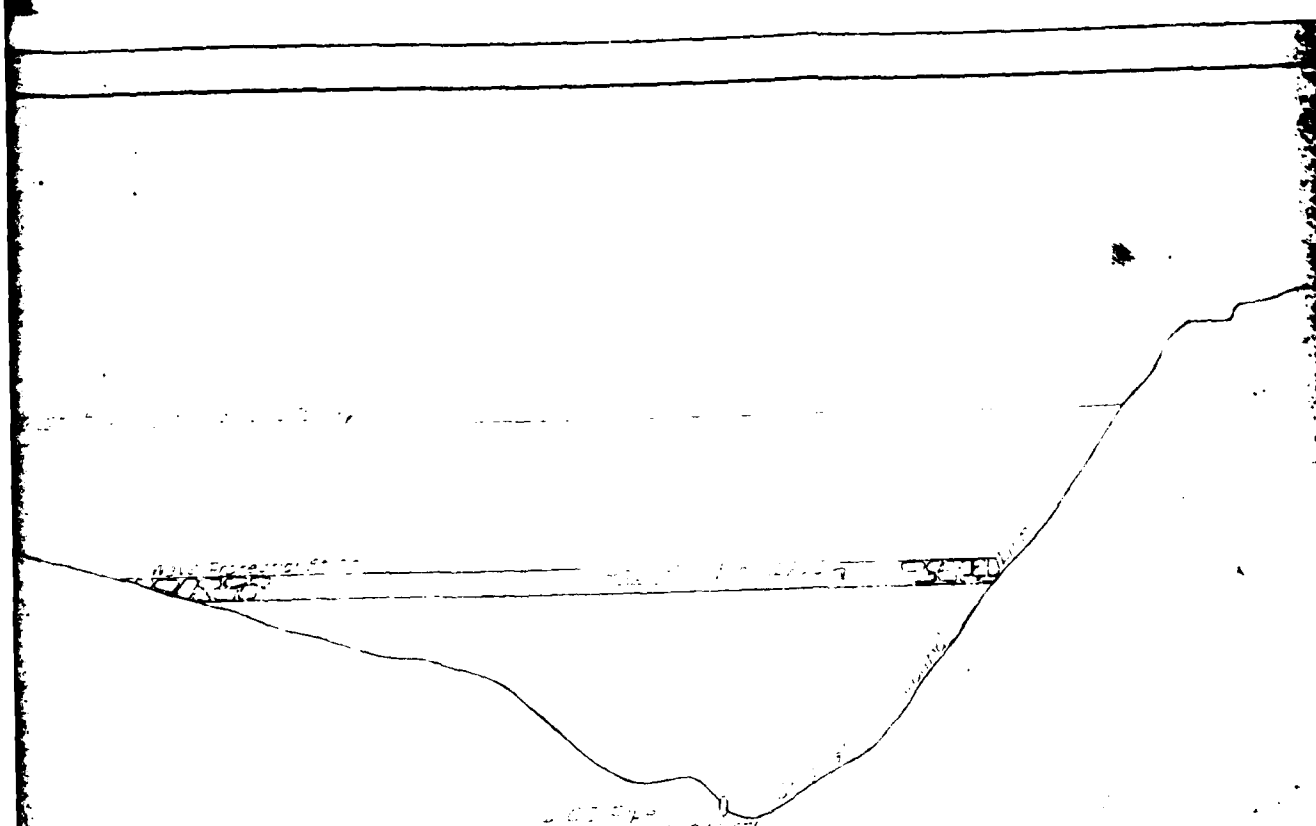

1280
1270
1260
1250
Curve 1
Curve 2
P.C.
P.T.
40'
40'



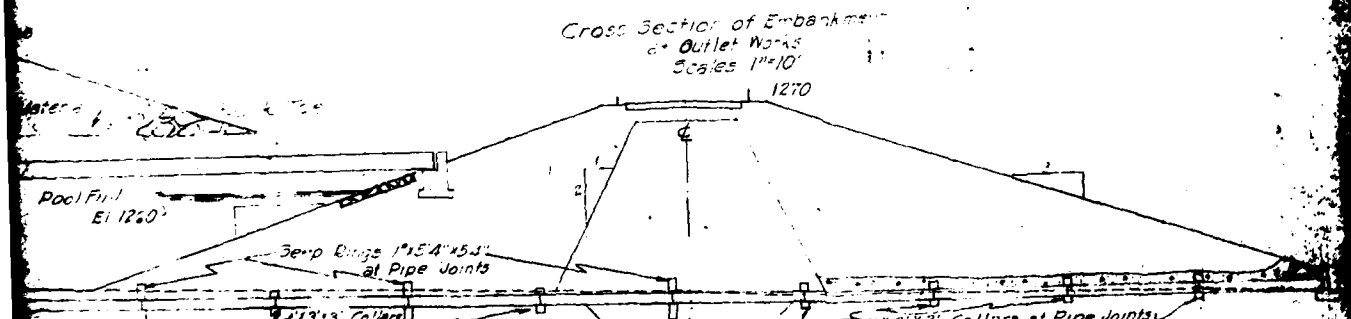
SAXONY
EMBANKMENT
Sheet 2 of 3
DATE

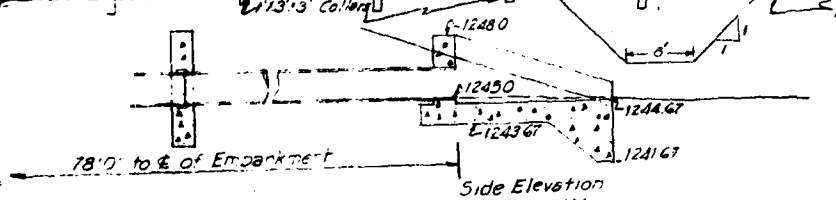
PLATE III



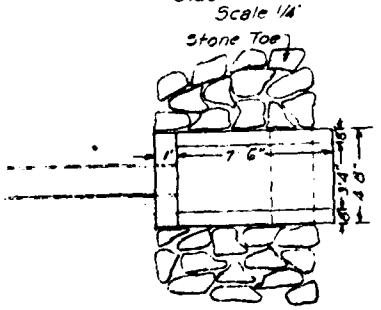


Cross Section of Embankment
at Outlet Works
Scales 1"=10'





Side Elevation
Scale 1/4"



Discharge Structure Plan
Scale 1/8"

Sec A-A

PROPOSED DAM, S...
PROFILES, SECTIONS...
OUTL...
Sheet 3 of 3
DATE June 1955

PLATE IV

GEOLOGY

Geomorphology

Lake Saxony Dam is located within the Pittsburgh Plateau section section of the Appalachian Plateau Physiographic Province. This area is characterized by gently folded sedimentary rocks which nave been deeply cut by streams to form steep sided valleys. Lake Saxony Dam is located near the head of Sarver Run, a tributary of Little Buffalo Creek. The valley bottom of Sarver Creek in the vicinity of the site is about 100 feet below the adjacent hilltops. These rounded hilltops are at about Elevation 1300 feet and, in a regional sense, are part of a broad, undulating plateau.

Structure

The site lies on the eastern flank of the Kellersburg Anticline, a northeast trending structure which plunges to the southwest. Strata in the immediate vicinity of the dam dip to the west at a rate of about 0.5 degrees. Faulting has not been documented in the area of the dam and no observations were made that would indicate faulting in the rocks outcropping around the dam.

Stratigraphy

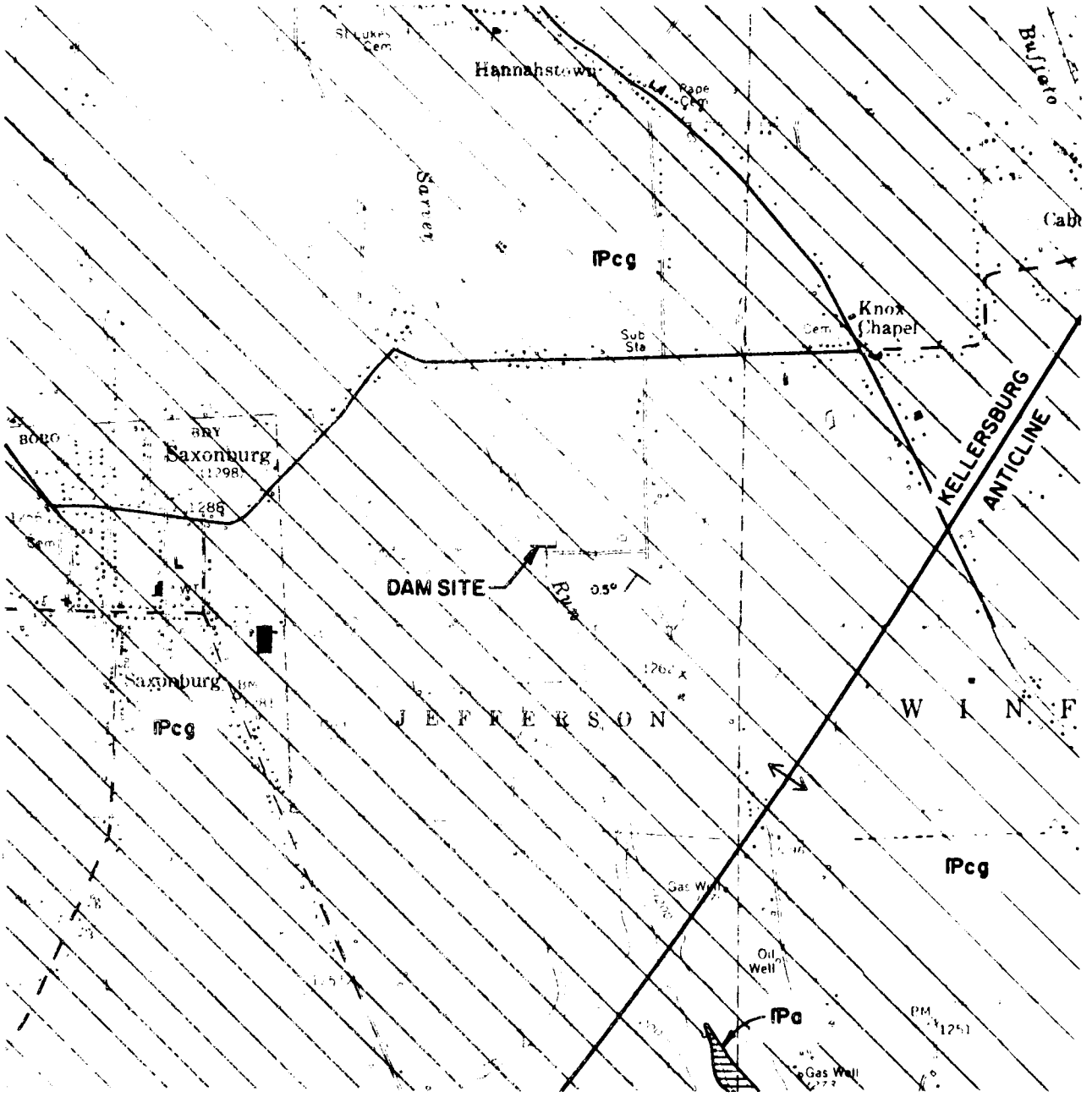
Rocks outcropping in the vicinity of the dam belong to the Glenshaw Formation of the Conemaugh Group which is Pennsylvanian in age. In general, this formation consists of cyclic sequences of sandstone, shale, red beds, thin limestone, and coal. Noteworthy are the landslide-prone red clay shales, known locally as the "Pittsburgh Red Beds." Ancient landslides are commonly associated with this stratigraphic sequence.

Mining Activity

The Upper Freeport coal seam, the uppermost unit of the Allegheny Formation, lies about 120 feet below the dam. This coal seam is unaffected by mining at the location of the dam. However, deep mining has occurred about 1.5 miles to the southeast.

APPENDIX F

GEOLOGY



SAXONBURG and CURTISVILLE QUADRANGLES, BUTLER COUNTY, PENNSYLVANIA

SCALE: 0 ½ MILE 1:24000

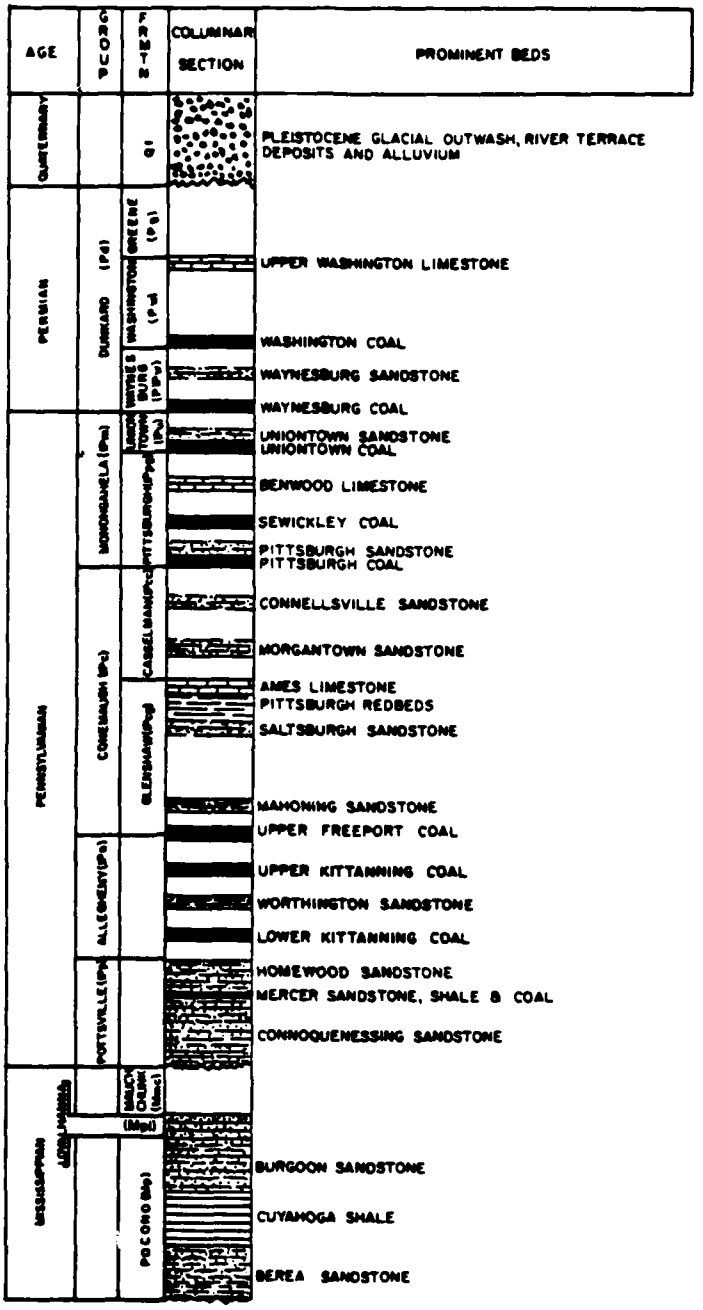
CONTOUR INTERVAL 20 FT. DATUM IS MEAN SEA LEVEL

——— FORMATION CONTACT

...APHIC AND GEOLOGIC SURVEY GREATER PITTSBURGH REGION
...9... and GREATER PITTSBURGH REGION STRUCTURE CONTOUR MAP, 1975

...E SAXONY DAM
...A ...AM INSPECTION PROGRAM
... & ASSOCIATES CONSULTING ENGINEERS

GEOLOGIC MAP



DATE: MAY 1981	LAKE SAXONY DAM NATIONAL DAM INSPECTION PROGRAM	GEOLOGIC COLUMN
SCALE: 1"=360		
DR: JF CK:	A. C. ACKENHEIL & ASSOCIATES, INC. CONSULTING ENGINEERS PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.	